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The Cathedral Engulfed: Sea-Level Rise, Property Rights, and Time

J. Peter Byrne

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Global climate change has and will lead to substantial rises in global sea levels. The now inevitable rise in sea levels poses new and difficult challenges to property rights and land-use regulation. Inundation and storm surges will physically destroy private and public property at great loss. But perhaps more fundamentally, the threats of such losses and the predictable efforts to contain them will call for new approaches to land-use regulation and strain traditional understandings of property rights in land. Neither the common law nor traditional notions of zoning contain legal resources adequate to cope with the economic, environmental, and human risks that sea-level rise will generate. New forms of regulation and shifts in the content of common law rules will generate novel claims of regulatory takings, confronting courts with puzzling questions of fundamental rights under unprecedented climatic conditions.

This Article seeks to clarify the kinds of regulatory takings questions that sea-level rise will generate, building on the emerging legal literature concerning adaptation to climate change. The Article unequivocally accepts the strong scientific consensus that global climate change is caused by human activity emitting greenhouse gases.[1] Prompt and far-reaching legal and cultural

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The title of this Article invokes the seminal article on the nature of property rights, Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089 (1972). The point only is to suggest how sea-level rise, and changes in the natural world more generally, may upend some settled and static notions about the "cathedral" of property law, something Calabresi and Melamed probably would not disagree with. The title also borrows from Claude Debussy's innovative prelude for piano, *La cathédrale engloutie*.

1. *See, e.g.*, Richard A. Muller, *The Conversion of a Climate-Change Skeptic*, N.Y. TIMES, July 30, 2012, at A19, *available at* http://www.nytimes.com/2012/07/30/opinion/the-conversion-of-a-climate-change-skeptic.html?pagewanted=all&_r=0; William D. Nordhaus, *Why the Global Warming Skeptics Are Wrong*, N.Y. REV. OF BOOKS (Mar. 22, 2012), http://www.nybooks.com/articles/archives/2012/mar/22/why-global-warming-skeptics-are-wrong.

reforms are needed to reduce global emissions.[2] However, questions of legal adaptation to global warming and other observable climate phenomena do not require adherence to any explanation for climate change, so long as the reader accepts the observable fact that seas are rising. Adaptation measures do not seek to mitigate or stop climate change but rather seek to change legal regimes to cope with its physical consequences.[3] Failure to adapt will put at hazard life, property, and vital ecological services. Even jurisdictions politically deadlocked over proposals to reduce greenhouse gases may accept the necessity for legal change to adapt to climate change. Of course, from the perspective of those who accept the *scientific* consensus about anthropogenic climate change,[4] political paralysis over mitigation increases the urgency for adaptation measures. Because of the greenhouse gases' durability in the atmosphere, serious warming will occur for many years even if humans presently find the capacity to dramatically reduce emissions.

The consequences that climate change has for natural resources upon which humans depend are impressive and varied. Increased heat, habitat modification, species extinctions, drought, extreme storms, and flooding pose large public health and resource management challenges, some of which have received extensive analysis in the legal literature.[5] Given the ecological importance of coastal areas and clustering of development within them, sea-level rise presents problems of great practical concern and compelling

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2. *See, e.g.*, Richard J. Lazarus, *Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future,* 94 CORNELL L. REV. 1153 (2009).

3. On the emerging law of adaptation, see THE LAW OF ADAPTATION TO CLIMATE CHANGE: U.S. AND INTERNATIONAL ASPECTS (Michael B. Gerrard & Katrina Fischer Kuh eds., 2012). For a comprehensive review of adaptation initiatives in the United States, see GEORGETOWN CLIMATE CTR., ADAPTATION CLEARINGHOUSE, http://www.georgetownclimate.org/adaptation/clearinghouse (last visited Sept. 28, 2012).

4. *Anthropogenic* means that human activity is a significant cause of climate change.

5. *See, e,g*., J.B. Ruhl, *Climate Change and the Endangered Species Act: Building Bridges to the No-Analog Future*, 88 B.U. L. REV. 1 (2008); Robin Kundis Craig, *Adapting Water Law to Public Necessity: Reframing Climate Change Adaptation as Emergency Response and Preparedness*, 11 VT. J. ENVTL. L. 709, 724 (2010) (noting the high costs that will result from a water shortage due to climate change); Jessica Grannis, Julia Wyman, Meagan Singer, Jena Shoaf & Colin Lynch, *Coastal Management in the Face of Rising Seas: Legal Strategies for Connecticut*, 5 SEA GRANT L. & POL'Y J. 59 (2012) (detailing local and state policy approaches to mitigate the impacts of sea-level rise); Victor B. Flatt, *Adapting Laws for a Changing World: A Systemic Approach to Climate Change Adaptation*, 64 FLA. L. REV. 269 (2012).

theoretical depth. Some islands, such as Maryland's Smith Island in the Chesapeake Bay, which has been settled since 1686, will surely disappear.[6] As has often been remarked, property and environmental conflicts are most acute where land meets the sea.[7] Not only do coastal areas present acute conflicts about balancing development and environmental protection, but the property rules and regulatory regimes regarding water and land differ markedly even though these natural elements are constantly interacting.[8] Judicial reports and law reviews are strewn with analyses of bitter disputes between collective action and individual interests in coastal regions.[9] Sea-level rise adds a vigorous catalyst to this already bubbling brew.

This Article focuses on regulatory takings law for its consideration of adaptation to sea-level rise. It does so even though regulatory initiatives for adapting to sea-level rise are in their infancy. Thus, the Article addresses general, proposed approaches to land-use regulation under discussion, rather than concrete regulatory initiatives under active conflict.[10] This approach may seem to put the cart before the horse; however, discussion of regulatory takings problems posed by regulatory adaptation to sea-level rise is already occurring and is an appropriate topic of this

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6. *See* Ben Giles, *Scientists Warn of Smith Island's Demise, Residents Are Skeptical*, THE BAY BEAT (Apr. 20, 2010), http://chesapeakebay.umd.edu/article/scientists-warn-smith-islands-demise-residents-are-skeptical.

7. *See, e.g.*, Richard Lazarus, *Changing Conceptions of Property and Sovereignty in Natural Resources Law: Questioning the Public Trust Doctrine*, 71 IOWA L. REV. 631, 647 (1986) (noting the public trust doctrine's historic focus on navigable waters).

8. Residents of low-lying, economically disadvantaged countries are likely to suffer far more grievous harm than will residents of the United States. Although legal adaptation measures in such areas are beyond the domestic focus of this Article, vulnerable residents of places like Bangladesh deserve the world's attention.

9. *See generally* Whaler's Vill. Club v. Cal. Coastal Comm'n, 220 Cal. Rptr. 2 (Cal. Ct. App. 1985) (concerning the right to protect one's property and the state's right to limit coastal development); McQueen v. S.C. Coastal Council, 580 S.E.2d 116 (S.C. 2003) (concerning a property owner's right to protect his land being overridden by the public trust doctrine); Niki L. Pace, *Wetlands or Seawalls? Adapting Shoreline Regulations to Sea Level Rise and Wetland Preservation in the Gulf of Mexico,* 26 J. LAND USE & ENVTL. L. 327 (2011) (examining the policy options available in the face of sea-level rise).

10. For greater discussion of land-use regulatory approaches, see J. Peter Byrne & Jessica Grannis, *Coastal Retreat Measures*, *in* THE LAW OF ADAPTATION TO CLIMATE CHANGE, *supra* note 3, at 267–306; JESSICA GRANNIS, ADAPTATION TOOL KIT: SEA-LEVEL RISE AND COASTAL LAND USE (2011), http://www.georgetownclimate.org/resources/adaptation-tool-kit-sea-level-rise-and-coastal-land-use.

Article for several reasons.[11] First, regulatory takings concerns are already central to discussions about the type of regulatory approaches that may be taken to address sea-level rise. Property owners disadvantaged by legal changes are quick to claim takings, and regulators are generally deterred by anxiety about takings litigation and liability. Thus, greater clarity about constitutional limits can guide regulatory choices or answer critics. Second, consideration of some new regulatory approaches needed to cope with sea-level rise highlights some of the absurdities of much of the regulatory takings doctrine. Insofar as the Supreme Court's conservative majority has pursued an ideal of essential, or natural, property rights unchangeable without compensation, the dynamic physical transformations promised by sea-level rise show the need for a more lenient and flexible constitutional approach recognizing that property rules do and must evolve in accord with social and ecological change.[12]

A central theme in this Article is the conceptual challenge posed by the dimension of time. Legal change to address future problems is inherently problematic, particularly when it entails immediate costs. This has played out in spades in political battles over efforts to reduce greenhouse gases but is a familiar issue in environmental law generally. Although sea-level rise is already occurring and legal efforts to adapt to it have begun, it will have far greater impact in the future. While such future sea-level rise is a near certainty, its pace and dimension can only be estimated. Thus, regulators may need to act based upon scientific predictions before concrete harms galvanize public opinion.

This Article also seeks to show that the futurity of harm creates opportunities for gradual and adaptive regulations, which can minimize harms and takings compensation requirements. A central thesis is that regulations adopted now, but having their principal regulatory effect only in the future upon the occurrence of some event, will create a dynamic legal response to increasing sea-level rise. Such dynamic regulations have the potential to provide

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11. The pioneering work in the field is James G. Titus, *Rising Seas, Coastal Erosion, and the Takings Clause: How to Save Wetlands and Beaches Without Hurting Property Owners,* 57 MD. L. REV. 1279 (1998). More recent thoughtful articles include Margaret E. Peloso & Margaret R. Caldwell, *Dynamic Property Rights: The Public Trust Doctrine and Takings in a Changing Climate,* 30 STAN. ENVTL. L.J. 51 (2011); Pace, *supra* note 9; Meg Caldwell & Craig Holt Segall*, No Day at the Beach: Sea Level Rise, Ecosystem Loss, and Public Access Along the California Coast,* 34 ECOLOGY L.Q. 533 (2007).

12. *See* Joseph L. Sax, *Property Rights and the Economy of Nature, Understanding* Lucas v. South Carolina Coastal Council, 45 STAN. L. REV. 1433 (1993).

effective environmental and social protections, to minimize harm to property owners, to preserve the public fisc, and to shape legal expectations appropriately. The Article thus presents four suggestions for regulatory architecture that employ this temporal dimension in legal adaptation to sea-level rise.

This Article proceeds as follows: Part I reviews the threat that sea-level rise poses to coastal resources. This involves both what can be said about how fast the seas will rise and what physical effects such rise will entail, as well as the economic and environmental consequences of such rise. Part II describes the chief types of regulatory responses to sea-level rise that can be anticipated and also presents the distinctive regulatory takings issues that each type of regulatory response can be expected to generate. While an infinite number of adaptations are conceivable, legal adaptations fall into a few discernable categories, each of which generates different regulatory takings problems. How these regulatory takings issues are resolved may determine how much each regulatory approach can be successfully implemented to minimize overall environmental, economic, and social harm. This Article argues that the most fruitful environmental response to sea-level rise is a retreat from the rising seas, i.e., development regulations that prevent most new construction and rebuilding in the zones most affected by sea-level rise. Retreat, however, also raises the most troubling takings issues. Thus, Part III of the Article presents possible approaches that conscientious regulators can take to encourage or mandate retreat while minimizing takings risks or liability. Each approach exploits the temporal dimension in sea-level rise—enacting legal changes now to facilitate more effective adaptation in the future as waters mount higher and storm surges come further inland.

I. SEA-LEVEL RISE

A. Rate and Projections

Rising seas will inundate low-lying coastal lands and increase the magnitude and frequency of storms. These forces will also combine to increase the erosion of coastal land. Together with the related problem of coastal subsidence, these forces threaten to destroy both development and environmental resources.

Sea levels are rising now at an accelerating rate and are projected to rise to levels that will inflict significant damage to human society. Over the past several years, the available data and modeling related to sea-level rise have significantly improved, allowing better predictions of ground conditions for the year

2100.[13] The projected sea-level rise has the potential to impact infrastructure seriously and adversely and may do so in ways that are currently impossible to predict. Evidence supports the possibility of abrupt climate events that could drastically worsen predictions. Indeed, one of the most alarming aspects of climate change is that it may contribute, along with other human-caused stresses on ecological systems, to a planetary "state shift" or tipping point, which may lead to sudden and dramatic changes in natural functions.[14]

Sea-level rise has been tracked since the late 1800s by tide-level gauges, and since 1993 changes have been recorded with high precision from altimeter satellites.[15] Consistent with the hypothesis of anthropogenic climate change, i.e., that human activity significantly contributes to it, the spread of industrialization and increasing emissions of greenhouse gases correlates with an accelerating increase in sea-level rise since this metric was first recorded. A recent study, for example, found an increasing rate of sea-level rise in recent years: from 1950 to 1993 it averaged 1.7 mm/year, while in the period from 1993 to 2009 it averaged 3.3 mm/year.[16] The increase can be traced primarily to the expansion of water as it warms and the melting of ice sheets. As global temperatures rise, the average ocean temperature also rises, and according to basic scientific principles, the volume of the heated water expands. This expansion has been estimated to account for approximately 30% of sea-level rise over the most recent period of measurements from 1993 to 2009.[17] The melting of polar and glacial ice has accelerated in pace with the increase in global temperatures. From 1993 to 2009, polar and glacial ice melting is estimated to contribute approximately 30% to sea-level

13. *See* U.S. GLOBAL CHANGE RES. PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES (2009), *available at* http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf (aggregating data from a variety of scientific papers to arrive at more accurate predictions for sea-level rise).

14. *See* Anthony Barnosky et al., *Approaching a State Shift in Earth's Biosphere,* 486 NATURE 52 (2012).

15. Robert J. Nicholls & Anny Cazenave, *Sea-level Rise and Its Impact on Coastal Zones*, 328 SCI. MAG. 1517 (2010); John A. Church & Neil J. White, *Sea-level Rise from the Late 19th to Early 21st Century*, 32 SURV. GEOPHYSICS 585 (2011) [hereinafter *Late 19th to Early 21st*]; John A. Church & Neil J. White, *A 20th Century Acceleration in Global Sea-Level Rise,* 33 GEOPHYSICAL RES. LETTERS L01602 (2006).

16. *Late 19th to Early 21st*, *supra* note 15; Nicholls & Cazenave, *supra* note 15, at 1517.

17. Nicholls & Cazenave, *supra* note 15, at 1517.

rise.[18] By the year 2100, this melting is expected to accelerate and ultimately contribute to 60%.[19]

Estimates of future sea-level rise depend on models projecting historic trends based on hypotheses about its causes. While sea-level rise clearly is accelerating, the rate of its future increases must remain uncertain. Researchers have varied in their projections as to the amount of sea-level rise that will take place by 2100. The Intergovernmental Panel on Climate Change's (IPCC) foundational 2007 report projected maximum sea-level rise of .59m. An aggregation of studies postdating the IPCC report indicates that the range for possible sea-level rise is much higher than .59m and by some estimates could reach close to 2m.[20]

While sea-level rise will be a global phenomenon, localities around the world and in the U.S. are likely to experience more rise than others. California is projected to experience sea-level rise ranging from 1.02m to 1.46m. The Gulf Coast is expected to experience sea-level rise in the range of .8m to 1.4m, depending on the model used.[21] A recent study of a sea-level rise "hotspot" in the Northeast, where rates well above global averages have been observed, suggests that complex changes in oceanic currents may lead to dramatically higher sea-level rise on that coastline.[22] New York City estimates that with rapid ice melting, it could face sea-level rise of more than seven meters.[23]

The above estimates of sea-level rise generally assume normal or linear changes in natural functions. However, other unseen factors or catastrophic changes in natural systems could drastically accelerate sea-level rise. The largest unknown factor is the behavior of ice sheets. Should significant decreases in ice-sheet volume occur, sea-level rise could be measured in tens of feet rather than by fractions of feet.[24] Another climatic change that could affect sea-level rise is the potential decrease in strength of

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18. *Id.*

19. *Id*. at 1518.

20. U.S. GLOBAL CHANGE RES. PROGRAM, *supra* note 13, at 25; Mark F. Meier et al., *Glaciers Dominate Eustatic Sea-Level Rise in the 21st Century,* 317 SCI. MAG. 1064 (2007).

21. Joseph F. Donoghue, *Sea Level History of the Northern Gulf of Mexico Coast and Sea Level Rise Scenarios for the Near Future*, 107 CLIMATIC CHANGE 17, 27 (2011).

22. Asbury H. Sallenger, Jr., Kara S. Doran & Peter A. Howd, *Hotspot of Accelerated Sea Level Rise on the Atlantic Coast of North America*, NATURE CLIMATE CHANGE (June 24, 2012), http://www.nature.com/nclimate/journal/vaop/ncurrent/pdf/nclimate1597.pdf.

23. N.Y.C. PANEL ON CLIMATE CHANGE, CLIMATE RISK INFORMATION 53 (2009), *available at* http://www.nyc.gov/html/om/pdf/2009/NPCC_CRI.pdf.

24. U.S. GLOBAL CHANGE RES. PROGRAM, *supra* note 13.

oceanic circulation in the North Atlantic. Circulation is predicted to decrease 25% to 30% in the upcoming century. Accordingly, sea levels are expected to rise due to a decrease in heat transfer. While these changes are ill understood and not well modeled, it is predicted that a complete collapse in circulation would result in at least a .76m increase in sea-level rise.[25]

The above projections only incorporate an increase in water levels and do not incorporate the impact of land subsidence. Climate change will interact with and contribute to territorial subsidence, which will exacerbate the coastal land loss. Subsidence is a complex phenomenon to which human actions contribute. Engineering of rivers and reduced flows may decrease sediment deposition, while groundwater depletion may exacerbate natural subsidence. A recent study examined the impact of groundwater depletion, concluding that approximately 42% of sea-level change can be attributed to withdrawals of water from terrestrial aquifers, which cannot be naturally replenished at a pace equal to the withdrawal rate.[26] Louisiana is a poster child for loss of coastal land due to combined subsidence and sea-level rise. Construction of flood-control levees and dredging of deep navigation channels have cut off flows of sediments from river to delta and have contributed to the loss of 1,900 square miles of Louisiana's coastal wetlands during the past century.[27] Louisiana continues to lose 25 to 35 square miles of wetlands each year[28] and is projected to lose up to 51 square miles of wetlands per year if significant corrective actions are not taken.[29]

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25. *Id*.

26. Yadu N. Pokhrel et al., *Model Estimates of Sea-Level Change Due to Anthropogenic Impacts on Terrestrial Water Storage*, 5 NATURE GEOSCIENCE 389 (2012). While this metric incorporates the mitigating effect of artificial sequestration (e.g., reservoirs), groundwater depletion has increased at a steady rate while reservoir impoundment of water has leveled off. Coastal cities such as Tokyo are already experiencing subsidence of up to 5 m. Nicholls & Cazenave, *supra* note 15, at 1518.

27. U.S. GLOBAL CHANGE RES. PROGRAM, *supra* note 13, at 149.

28. *Louisiana Begins Wetland Repair with Mississippi River Sediment*, ENV'T NEWS SERV. (Apr. 14, 2009), http://www.ens-newswire.com/ens/apr2009/2009-04-14-093.asp. *See also* Oliver A. Houck, *Land Loss in Coastal Louisiana: Causes, Consequences, and Remedies,* 58 TUL. L. REV. 3 (1983).

29. COASTAL PROT. & RESTORATION AUTH. OF LA., LOUISIANA'S COMPREHENSIVE MASTER PLAN FOR A SUSTAINABLE COAST 87 (2012), *available at* http://www.lacpra.org/assets/docs/2012%20Master%20Plan/Final%20Plan/2012%20Coastal%20Master%20Plan.pdf.

B. Consequences

The consequences of the projected sea-level rise can be grouped into three categories: environmental, social, and economic. Primarily environmental consequences consist in the loss of coastal islands, wetlands, and sand dunes to rising waters. These coastal lands provide essential habitat and ecological services such as water purification and storm protection.[30] A 1m increase in sea level would inundate approximately 65% of U.S. coastal marshlands, an ecosystem home to numerous endangered species that also provides a protective barrier for inland areas from wave action and storms.[31] Sea-level rise poses similar threats to the health of coral reefs.[32] Increasingly large levels of saltwater intrusions into local aquifers can also be expected, contaminating the water supply for both humans and coastal flora–fauna dependent on freshwater.[33]

Societal impacts of sea-level rise largely stem from much of the United States population living near the coast. The residences of approximately 3.7 million people would be inundated if sea levels were to rise by one meter.[34] Nearly 23 million people live within six meters of the mean high tide line. If these people are not inundated during this century, they will be exposed to greater risk of flooding in storms.[35] Sea water incursions and storm surges may salinate freshwater supplies, causing more dislocation.[36]

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30. Ecological services are the benefits conferred on humans by the natural functioning of ecosystems and are often taken for granted because they need not be purchased in the market. *See generally* NATURE'S SERVICES: SOCIETAL DEPENDENCE ON NATURAL ECOSYSTEMS (G.R. Daily ed., 1997); James Salzman, *A Field of Green? The Past and Future of Ecosystem Services*, 21 J. LAND USE & ENVTL. L. 133 (2006).

31. Donoghue, *supra* note 21, at 27. More recent studies have been broadly consistent with figures from past reports, finding a 44% loss of wetlands by 2080 from a 72 cm rise in sea level. U.S. CLIMATE CHANGE SCI. PROGRAM, COASTAL SENSITIVITY TO SEA-LEVEL RISE: A FOCUS ON THE MID-ATLANTIC REGION 64 (2009), *available at* http://www.climatescience.gov/Library/sap/sap4-1/final-report/sap4-1-final-report-all.pdf.

32. U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 31, at 182.

33. *Id.* at 21.

34. Benjamin H. Strauss et al., *Tidally Adjusted Estimates of Topographic Vulnerability to Sea Level Rise and Flooding for the Contiguous United States*, 7 ENVTL. RES. LETTERS (2012), http://iopscience.iop.org/1748-9326/7/1/014033/pdf/1748-9326_7_1_014033.pdf.

35. *Id.*

36. Grant Ferguson, *Vulnerability of Coastal Aquifers to Groundwater Use and Climate Change*, 2 NATURE CLIMATE CHANGE 342 (2012). The combination of sea water incursions and reduced fresh water flows, due to drought, recently have required some communities in Louisiana to forgo use of

California's Sacramento–San Joaquin River Delta (with its network of rivers, levees, and dams), the center of the state's water infrastructure, has been assessed as "unsustainable" by state authorities, given the projected increase in sea-level rise and decline in precipitation over the next century.[37] Displacement of so many people, even if gradual, will be traumatic. Moreover, social conflict over managing such changes will become a persistent feature of local, state, and national political life.

In addition to environmental and social impacts, sea-level rise will produce serious economic consequences. For example, the State of New York has approximately $2.3 trillion in insured coastal property.[38] New York City alone has 33,000 buildings, worth $18.3 billion, in the historic 100-year flood zone.[39] Norfolk, Virginia, a dynamic regional employment center, anticipates needing $1 billion over the next 30 years to construct floodgates and drains because of current and anticipated sea-level rise and land subsidence.[40]

The economic impact of sea-level rise could wreak havoc on the country's infrastructure and cripple the economy. For example, sea-level rise threatens six out of the country's top ten freight gateways (measured by value of shipments).[41] In the Gulf Coast

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their normal water supplies and purchase water from New Orleans, which itself is threatened with future salination. *See* Richard Rainey, *Saltwater Wedge Reaches Chalmette: Plaquemines Buys N.O. Water*, NOLA.COM (Aug. 15, 2012, 6:56 PM), http://www.nola.com/politics/index.ssf/2012/08/saltwater_wedge_reaches_chalme.html.

37. CAL. DEP'T OF WATER RES., DELTA RISK MGMT. STRATEGY, FINAL PHASE 1 RISK REPORT: SECTION 14 (RISK ANALYSIS FOR FUTURE YEARS) 29 (2009), *available at* http://www.water.ca.gov/floodsafe/fessro/levees/drms/docs/Risk_Report_Section_14_Final.pdf.

38. U.S. GLOBAL CHANGE RES. PROGRAM, *supra* note 13, at 109.

39. Jeroen C. J. H. Aerts & W. J. Wouter Botzen, *Managing Exposure to Flooding in New York City*, 2 NATURE CLIMATE CHANGE 377 (2012). The 100-year flood zone is an area which has a 1% chance of flooding in any one year. Robert R. Holmes, Jr. & Karen Dinicola, U.S. Geological Survey, *100-Year Flood—It's All About Chance* (2010), *available at* http://pubs.usgs.gov/gip/106/pdf/100-year-flood_041210web.pdf.

40. *See* Darryl Fears, *Built on Sinking Ground, Norfolk Tries to Hold Back Tide amid Sea-Level Rise,* WASH. POST (June 17, 2012), http://www.washingtonpost.com/national/health-science/built-on-sinking-ground-norfolk-tries-to-hold-back-tide-amid-sea-level-rise/2012/06/17/gJQADUsxjV_story.html. Norfolk's planning comes against a state political background in which legislators refused to use the words "sea-level rise" or "climate change" in legislation authorizing a study of such phenomena. *Id*.

41. Nicholls & Cazenave, *supra* note 15, at 62. Of the county's top ten freight gateways, the ports of JFK International Airport, Los Angeles, New

alone, thousands of miles of roadways and hundreds of freight railways are in jeopardy of being permanently flooded due to sea-level rise.[42] Aside from transportation infrastructure, a significant portion of the country's energy infrastructure is positioned in coastal areas, and sea-level rise will result in direct losses from equipment damage and high relocation or armoring costs to protect these facilities. Tourism infrastructure will also be heavily damaged, resulting in local economic depressions for communities that depend heavily on the industry. Many beachfront homes will be inundated.[43]

C. Property Rights and Sea-Level Rise

Sea-level rise will change property boundaries. Unimpeded, rising sea levels will divest private property owners and shift ownership to the public as sea water slowly inundates formerly dry land. This is the background legal reality that shapes analysis of the property rights and takings implications of regulatory strategies.

Under the law of every state, the land under the sea essentially belongs to the public.[44] The public trust doctrine, with roots in Roman law and English common law, currently composed of both state and federal common law, as well as constitutional elements, provides for public rights over the bed and banks of navigable

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York, Long Beach, Los Angeles International Airport, and Houston are vulnerable to sea-level rise.

42. U.S. GLOBAL CHANGE RES. PROGRAM, *supra* note 13, at 62. California's transportation infrastructure is similarly at risk. MATTHEW HEBERGER ET AL., CAL. CLIMATE CHANGE CTR., THE IMPACTS OF SEA-LEVEL RISE ON THE CALIFORNIA COAST 54 (2009), *available at* http://www.pacinst.org/reports/sea_level_rise/report.pdf.

43. Admittedly, some previously inland homes will acquire direct beach access, although of uncertain value. As Hurricane Katrina showed, the consequences of sea-level rise are likely to have a disparate impact upon low-income communities that lack the resources to adapt, recover, or escape. The United States is less at risk than other countries because of its geography and wealth. In Bangladesh, many of its 158 million impoverished citizens live within 20 feet of sea level; the government estimates that 20 million people will need to be resettled as soon as 2050. Dan Morrison, *Come Hell with High Water*, N.Y. TIMES (Jan. 20, 2012, 7:36 AM), http://latitude.blogs.nytimes.com/2012/01/20/bangladesh-faces-environmental-calamity-if-carbon-emissions-arent-cut. The challenges of adaptation in the United States, though daunting, are quite manageable by comparison.

44. Pollard v. Hagan, 44 U.S. 212 (1845).

waters and tidelands.[45] These public rights include access for navigation, fishing, and often recreation, as well as for environmental protection.[46] At the coast, the public's rights generally extend up to the mean high-tide line.[47] The public trust is broad and vague, but it provides the public with property rights superior to any private owner on the lands and waters to which it applies.[48]

As rising seas move the line between public tidelands and private dry lands farther upland, private owners will lose land to the public as it becomes subject to tidal wash. This is the effect of the ancient doctrine of *accretion*, which provides that slow or imperceptible changes in physical boundaries set by water courses change legal ownership.[49] A sudden, perceptible change in a water boundary, known as *avulsion*, does not change ownership, which remains at the line of the prior physical boundary.[50] Sea-level rise is incremental, and therefore, corresponding land loss will be subject to the doctrine of accretion and will deprive private land owners of their property rights in the inundated lands.[51] Thus, under existing law, sea-level rise, which generally proceeds slowly and incrementally, will deprive littoral owners of land ownership. Accretionary loss has never been considered a taking, constitutionally requiring public compensation, because nature, rather than the state, effects the deprivation. Loss of littoral land through accretion might be understood to be a risk that "inheres in the title" to such land.[52]

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45. *See, e.g.*, Alexandra B. Klass, *Modern Public Trust Principles: Recognizing Rights and Integrating Standards*, 82 NOTRE DAME L. REV. 699 (2006).

46. Marks v. Whitney, 491 P.2d 374, 380 (Cal. 1971).

47. Pace, *supra* note 9.

48. *See* J. Peter Byrne, *The Public Trust Doctrine, Legislation, and Green Property, A Future Convergence?,* 45 U.C. DAVIS L. REV. 915 (2012).

49. *See* Joseph L. Sax, *The Accretion/Avulsion Puzzle: Its Past Revealed, Its Future Proposed*, 23 TUL. ENVTL. L.J. 305 (2010).

50. Nebraska v. Iowa, 143 U.S. 359, 366–67 (1892).

51. Coastline movement due to storms, even though sudden and, thus, avulsion, also moves property lines. As the Texas Supreme Court held that public easements cannot move inland due to avulsion, it affirmed that the line between public trust and private uplands did move due to the same events. Severance v. Patterson, 370 S.W.3d 705, 723 (Tex. 2012) ("[W]hile losing property to the public trust as it becomes part of the wet beach or submerged under the ocean is an ordinary hazard of ownership for coastal property owners, it is far less reasonable, and unsupported by ancient common law precepts, to hold that a public easement can suddenly encumber an entirely new portion of a landowner's property or a different landowner's property that was not previously subject to that right of use.").

52. *See* Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1029 (1992).

That sea-level rise will, over time, deprive owners of their littoral property without compensation is an important background principle in assessing whether regulation of property use before the sea-level rise should be considered a taking. Owners have every incentive to block such loss by armoring their property with sea-walls, but such structures will deprive the public of their right to new public trust lands and cause a variety of other harms. The prospect of uncompensated loss also changes what can be considered the "property as a whole" under the standard approach to identifying a regulatory taking. As the rate of sea-level rise becomes clearer and more broadly understood, it will affect littoral land's market price, generally lowering it. Such land may become uninsurable. In assessing whether a regulation reduces the economic value of littoral land, the economic effects of the regulation must be distinguished from the economic effects of sea-level rise itself.[53]

Are the rules of accretion and avulsion subject to legislative change to perpetuate the ownership rights of upland property owners? State legislatures might provide through statute that upland owners retain ownership rights despite being submerged, abrogating the traditional understanding of accretion. To be sure, the accretion–avulsion rules may be criticized as excessively formalistic. They developed long ago under quite different economic and environmental conditions and before modern surveying methods.[54] Coastal land in pre-modern times did not enjoy a premium because of leisure amenities. Most conspicuously, the doctrine of accretion seemed fair when it was assumed that waters could rise or fall in equal probability, so that a littoral owner could be advantaged at one time and disadvantaged at another.[55] Climate-induced sea-level rise ensures that littoral owners will be net losers from accretion for the foreseeable future, undermining the justice of the rule. The accretion and avulsion doctrines seem to be merely common law solutions for the practical problem of ascertaining boundaries after physical change obliterates former boundaries. These two concepts apparently enjoy no constitutional status that would immunize them from legislative reform.

On the other hand, abrogating the rules of accretion for littoral owners would deprive the public of the traditional right of access

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53. On the other hand, land saved from sea-level rise through public armoring may see a relative increase in market value, although this would be attributable to the public subsidizing of levees or other works.

54. Sax, *supra* note 49, at 320.

55. *See infra* notes 121–22 and accompanying text.

to the shoreline provided under the public trust doctrine. Such a change would prospectively prevent the public from accessing tidelands or submerged lands even though those rights always have been tied to the physical condition of such water boundaries. Arguably, such tidelands are far better suited and more valuable for public access than for private ownership or use.[56] Although the Takings Clause would not protect public land against a taking for private use, a provocative asymmetry, most states' public trust doctrines have established limits against alienation of public trust lands not for public trust ends.[57] Such a limitation could invalidate a rule aimed at preventing the expected increase of public trust lands through accretion, although that raises the long-standing ambiguity of whether the public trust doctrine is constitutional under a state's law. In any event, the public may oppose such elimination of public rights.

Also, the Supreme Court has given precedence to the doctrines of accretion and avulsion over statutory changes in the context of takings challenges. In *Stop the Beach Renourishment v. Florida Department of Environmental Protection*, the Court upheld the Florida Supreme Court's ruling that Florida's Beachfront Management Act did not change the rights of littoral owners because the statute duplicated the results that the doctrine of avulsion already provided.[58] It is striking that the Court gave so much weight to this obscure common law principle rather than assessing the underlying statute's inherent fairness or rationality. As I have written elsewhere, the turn to common law essentialism in regulatory takings doctrine threatens to perpetuate outdated rules and divert attention from whether statutes address new environmental challenges in accord with basic fairness.[59] Thus, judicial conservatism probably will retain the accretion–avulsion distinction simply because it has endured for a long time.

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56. Carol Rose, *The Comedy of the Commons: Custom, Commerce, and Inherently Public Property*, 53 U. CHI. L. REV. 711 (1986).

57. *See* Ill. Cent. R.R. Co. v. Illinois, 146 U.S. 387 (1892) (holding legislature's conveyance away of public trust land beneath navigable waters ineffective).

58. Stop the Beach Renourishment, Inc. v. Fla. Dep't of Envtl. Prot., 130 S. Ct. 2592 (2010). This decision is considered more fully below in the section addressing soft armoring of the coastline.

59. J. Peter Byrne, *Rising Seas and Common Law Baselines: A Comment on Regulatory Takings Discourse Concerning Climate Change,* 11 VT. J. ENVTL. L. 625, 642 (2010).

D. Market Mechanisms; Flood Insurance

This Article concentrates on land-use regulation and other forms of government mandates to adapt to sea-level rise, both because such regulation is indispensible for reasonable problems, and because it is a precondition for the Takings Clause analysis at its center. However, this Article does not purport to slight cooperative and market mechanisms, which can have great value in certain situations, at least when market incentives provide support to public-spirited motivation. Private owners may manage their land so as to protect environmental or other collective values. Private organizations, such as land trusts, or state and local governments, may purchase land or conservation easements to promote ecological services under new coastal conditions. Such activity has great value because it avoids coercion and can proceed in advance of the formation of political majorities responding to crisis. But such activity is generally incentivized by tax breaks and other public payments, which make such private actions more economically plausible. However, there will never be enough money to incentivize voluntary adaption on a scale necessary to cope with sea-level rise. Moreover, in some circumstances, basic social morality is undermined when payments are made to a landowner simply because that landowner has chosen not to engage in development that harms life or ecosystems.[60]

Broad political support should exist for the abolition of public subsidies that exacerbate the risks of sea-level rise. Reform of the National Flood Insurance Program (NFIP), administered by the Federal Emergency Management Agency (FEMA), seems the most obvious and urgent legal step to adapt to sea-level rise.[61] The NFIP was enacted because private insurers were fleeing the market due to catastrophic losses from storms and flooding. It provides federal insurance against such hazards at submarket rates in exchange for local adoption of building codes and land-use measures thought to lessen storm and flood risks. The NFIP has grown to a massive special interest that has promoted excessive land development of coastal areas by socializing the risks of private building by the sea.

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60. *See* John D. Echeverria, *Regulating Versus Paying Land Owners to Protect the Environment*, 26 J. LAND RESOURCES ENVTL. L. 1 (2005).

61. *See* CONGRESSIONAL BUDGET OFFICE, THE NATIONAL FLOOD INSURANCE PROGRAM: FACTORS AFFECTING ACTUARIAL SOUNDNESS (2009), *available at* https://www.cbo.gov/sites/default/files/cbofiles/ftpdocs/106xx/doc10620/11-04-floodinsurance.pdf; JUSTIN R. PIDOT, COASTAL DISASTER INSURANCE IN THE ERA OF GLOBAL WARMING: THE CASE FOR RELYING ON THE PRIVATE MARKET (2007), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1695697.

The local-government development restrictions required by the NFIP are inadequate even without the increased risks of climate change. Even more alarming, the flood maps used to assess risks do not in any way take into account the certainty of future sea-level rise. Federal law has required that flood maps be calculated only on historic flood experiences and does not permit FEMA to take into account scientific models predicting increased future flooding due to climate change and other factors.

Congress very recently enacted legislation reforming some aspects of NFIP.[62] The statute directs FEMA to revise flood maps based upon "future changes in sea levels, precipitation, and intensity of hurricanes"[63] and to develop recommendations about how to incorporate climate change into regulatory maps.[64] It may not grant FEMA the authority to actually affect development decisions, such as adjusting flood insurance premiums based upon the increased risk due to sea-level rise.[65] Nonetheless, the Act does allow FEMA to develop more realistic flood maps, which local governments can use in crafting land-use regulations. Also, the Act phases out insurance subsidies for new homes, second homes, and properties subject to repetitive loss, and allows FEMA to raise premiums across the board to higher (but still capped) maximums.[66] The Act, while imperfect to be sure, demonstrates the capacity for Congress to enact legislation to eliminate subsidies for nonsensical behavior in light of sea-level rise. It was a small price to pay for constructive legislation that all references to climate change were eliminated from the Act's language in the final conference.[67]

Reforming flood insurance shows how market incentives can promote land use adaptation to sea-level rise without incurring taking problems. Eliminating insurance subsidies requires coastal residents to bear more of the real costs of doing so. Such costs

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62. Biggert–Waters Flood Insurance Reform Act of 2012, Pub. L. No. 112-141, 126 Stat. 405 (codified as amended at 42 U.S.C. § 4001–4129). *See also* Jessica Grannis, *Analysis of How the Flood Insurance Reform Act of 2012 (H.R. 4348) May Affect State and Local Adaptation Efforts*, GEORGETOWN CLIMATE CTR. (2012), http://www.georgetownclimate.org/sites/default/files/Analysis%20of%20the%20Flood%20Insurance%20Reform%20Act%20of%202012.pdf.

63. 42 U.S.C. § 100216(b)(3)(D) (2012).

64. *Id.* § 100216.

65. *See id*. § 100211 (amending 42 U.S.C. § 4015). FEMA may still only establish insurance premiums based upon consideration of the "average historical loss year." *Id.*

66. *Id*. § 100205 (amending 42 U.S.C. §§ 4014 & 4015(e)).

67. *See* Evan Lehmann, *'Global Warming' Disappears from Flood Legislation*, CLIMATEWIRE (July 3, 2012), *available at* http://rstreet.org/wp-content/uploads/2012/07/flood-climate.pdf.

should encourage retreat from rising seas and the choice to live further inland.

II. ADAPTATION TO SEA-LEVEL RISE AND REGULATORY TAKINGS

This Part of the Article seeks to identify the takings issues raised by each type of regulatory response to sea-level rise. There are three possible regulatory responses to sea-level rise: defense, retreat, or accommodation. The first two already have and will continue to present significant regulatory takings issues. The third, accommodation, refers to building codes that require structures to be raised or reinforced to withstand floodwaters.[68] Such building codes frequently reside in local regulations designed to meet the NFIP's requirements. These requirements have not given rise to takings claims and, as safety rules that expressly permit development, are unlikely to do so.

Defense and retreat measures both engage property rights and present challenging, if different, regulatory takings issues. This Part will explain the purposes of and mechanisms for defense and retreat measures and then explicate the takings issues that each generates. Neither is different from regulatory steps taken in the past to address flooding or erosion, but the scale and ubiquity of sea-level rise will require their deployment to a degree that should stimulate fresh thinking about both regulatory design and the nature of constitutional protection for private property. Part III of this Article will propose time-triggered approaches to retreat regulations that seek a new balance between collective protections and private rights.

Before considering the variety of regulatory responses to sea-level rise, a brief general introduction to the Takings Clause may be helpful. The Fifth Amendment to the U.S. Constitution provides: "[N]or shall private property be taken for public use, without just compensation."[69] It was intended to condition the exercise of eminent domain on compensation.[70] Understandably, it was extended to require compensation when the government otherwise physically takes possession of property without the formalities of condemnation[71] and was applied to the states through the Fourteenth Amendment.[72] In modern times, courts

68. GRANNIS, *supra* note 10, at 23.
69. U.S. CONST. amend. V.
70. *See* William Michael Treanor, *The Original Meaning of the Takings Clause and the Political Process*, 95 COLUM. L. REV. 782 (1995).
71. *See* Pumpelly v. Green Bay Co., 80 U.S. 166 (1871).
72. *See* Chi., Burlington & Quincy R.R. Co. v. City of Chicago, 166 U.S. 226 (1897).

have established that regulation of property use, without any dispossession, can amount to a taking if the economic consequences to the owner are severe enough.[73] This regulatory takings doctrine provides far and away the most significant constitutional limitation on state and local land-use regulatory authority.

The Supreme Court's 1978 *Penn Central* decision canonized an ad hoc, fact-sensitive approach to determining whether a regulation effects a regulatory taking.[74] The Court upheld New York City's historic preservation law, which prohibited the owner from adding a massive modernist tower above iconic Grand Central Station. The opinion balanced the economic injury to the owner, especially the degree to which the regulation frustrated its reasonable investment-backed expectations, with the character and purpose of the government's actions. Subsequently, the Court established two circumstances in which a regulation can effect a taking per se, that is, without any balancing of competing factors: when a regulation authorizes a permanent physical invasion[75] and when it deprives the owner of *all* economic value.[76] Critics argue that the regulatory takings doctrine lacks persuasive basis in the Constitution's language, history, or early interpretation.[77] Nonetheless, property rights advocates and several sympathetic Supreme Court Justices have striven to expand the doctrine's reach and strength to become a primary substantive limitation on government power over private property.[78] All of this is relevant to understanding how the judicial interpretation of the Takings Clause may shape legal adaptation to sea-level rise.

A. Hard Armoring

The prospect of fighting back against sea-level rise may invoke images of ancient King Canute ordering back the sea, a persistent icon of human and governmental futility.[79] Yet there have been

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73. *See, e.g.*, Pa. Coal Co. v. Mahon, 260 U.S. 393 (1922).
74. Penn Cent. Transp. Co. v. City of New York, 438 U.S. 104 (1978).
75. Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419 (1982).
76. Lucas v. S.C. Coastal Council, 505 U.S. 1003 (1992).
77. *See generally, e.g.*, Byrne, *supra* note 48; Treanor, *supra* note 70; Sax, *supra* note 49; Lazarus, *supra* note 2; Echeverria, *supra* note 60.
78. *See, e.g.*, RICHARD EPSTEIN, TAKINGS: PRIVATE PROPERTY AND THE POWER OF EMINENT DOMAIN (1985) (arguing that any net diminution in value requires compensation); James S. Burling, *Private Property Rights and the Environment After* Palazzolo, 30 B.C. ENVTL. AFF. L. REV. 1 (2002).
79. Contrary to how the Canute story is usually interpreted, the King may have intended to convey to his followers the limits of governmental power. *See*

notable successes in building structures to protect or reclaim dry land from the sea and from flood waters. Building structures to hold back the sea generally is referred to as *armoring*. Such structures can consist of construction materials, such as steel and concrete used in levees and bulkheads, which are referred to as *hard armoring*. They may also employ natural and living materials to build or restore beaches, sand dunes, or wetlands, in which case they are referred to as *soft armoring*.[80]

Both forms of armoring interpose higher elements to shield dry land from sea water, and both involve significant expense in engineering, constructing, and maintaining structures that can withstand the pressures of nature. Plainly, armoring the entire coast will never be economically feasible or even rational.[81] Levees will certainly protect areas of intense development, like Manhattan, and beaches valuable for recreation and tourism will be restored. Armoring most of the shoreline, however, cannot be justified. Moreover, armoring causes significant environmental harms. Hard armoring will eliminate the intertidal area as seas rise, and it often increases erosion of neighboring properties by increasing current and wave action laterally against unprotected shorelines. Soft armoring causes less environmental harm because it mimics natural shorelines, but its capacity to preserve ecological services performed by natural shorelines has not been clearly established.[82] Each method of armoring performs differently under different environmental conditions. While each raises takings problems, the issues that they raise seem quite different.

Hard armoring can be accomplished by either private or public action. Private property owners can construct bulkheads on the seaward boundaries to reclaim land or to shield development from sea water. Private armoring in itself does not threaten any taking because it lacks state action. It does, however, threaten tort liability because the construction of a levee on one property may damage neighboring land by redirecting or intensifying wave or current action, thereby increasing erosion.[83] Historically, most states have

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Kathryn Westcott, *Is King Canute Misunderstood?*, BBC NEWS MAG. (May 26, 2011, 7:41 PM), http://www.bbc.co.uk/news/magazine-13524677.

80. *See* Robert R.M. Verchick & Joel D. Scheraga, *Protecting the Coast*, *in* THE LAW OF ADAPTATION TO CLIMATE CHANGE, *supra* note 3, at 235–65.

81. *See* Byrne & Grannis, *supra* note 10.

82. *See* Verchick & Scheraga, *supra* note 80.

83. *See* Wendy B. Davis, *Reasonable Use Has Become the Common Enemy: An Overview of the Standards Applied to Diffused Surface Water and the Resulting Depletion of Aquifers,* 9 ALB. L. ENVTL. OUTLOOK J. 1, 9–12 (2004) (noting that at present a large minority of states have adopted the

held armoring owners free from liability to their eroding or flooded neighbors under what has been termed the *common enemy rule* for repelling floodwaters.[84] In short, the rule provides that every property owner can take whatever actions on his own land that he wishes without incurring liability to neighboring owners from causing increased flooding or other harms. Many states have taken the more modern approach of imposing a reasonableness standard on such self-protection.[85] The serious taking issue that relates to private armoring stems from regulations prohibiting such armoring as a means of encouraging retreat from rising waters. That issue will be addressed below in Part II.C.

Government-built or -authorized levees raise a variety of takings issues.[86] Some may be straightforward, such as the expropriation of land for construction of public levees, but even here the existence of some kinds of public easements may shield the government from liability.[87] The more interesting issues stem from flooding caused by government action. Government-authorized construction that causes a permanent flooding has long been viewed as a taking.[88]

Such issues have often arisen under the federal flood-control programs. The Flood Control Act of 1928,[89] under which the U.S. Army Corps of Engineers has built and manages the levee system

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reasonable use doctrine regarding a property owner's right to combat surface waters, with another significant minority following a modified rule allowing a finding of liability due to negligence or trespass).

84. *See id.* at 13.

85. It may also be that state or local permitting of armoring may violate state public trust doctrines, because it would in some instances diminish public trust coastal resources. *Cf.* Nat'l Audubon Soc'y v. Superior Court (Mono Lake), 658 P.2d 709 (Cal. 1983) (suggesting that state recognition of water rights may violate public trust doctrine), *cert. denied sub nom.* L.A. Dep't of Water & Power v. Nat'l Audubon Soc'y, 464 U.S. 977 (1983). I am indebted to Jessica Grannis for this suggestion.

86. There does seem also to be an argument that publically constructed hard armoring may violate the public trust doctrine when it causes the destruction of public trust tidelands through erosion. Such construction essentially transfers property rights from the public to adjacent private owners without furthering public trust values; indeed, they eliminate opportunities for public access over the tidelands and undermine the environmental services that tidelands provide.

87. *See* Eldridge v. Trezevant, 160 U.S. 452 (1896) (finding that Louisiana levee easement shields from Fifth Amendment compensation requirement expropriation of land to erect a levee).

88. *See e.g.*, Pumpelly v. Green Bay Co., 80 U.S. 166 (1872) (noting that permanent government-authorized flooding would be considered a taking per se); Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419, 428 (1982).

89. 33 U.S.C §§ 701–709b (2006).

on the Mississippi River and its tributaries, provides the United States with immunity for tort liability for flooding resulting from operation of the system.[90] Litigants continue to test the limits of that immunity.[91] Of course, no statutory immunity can shield the government from constitutional takings liability, so litigants seek to characterize flooding losses attributable to government management of the federal system as takings. This has led to stress on the line between tort and takings. While negligent or inadvertent government flooding of private property cannot readily be characterized as a taking, a variety of deliberate or foreseeable flooding may be, although such claims face a host of formal or conceptual barriers.[92]

The complexities of and potential for such flooding–takings claims can be seen in *Big Oak Farms, Inc. v. United States*, a recent decision of the Court of Federal Claims.[93] Plaintiffs owned land in the Birds Point–New Madrid Floodway in Missouri that was deliberately flooded by the Corps, according to the established plan for flood control, by breaching a levee to relieve flood risk to the upstream city of Cairo, Illinois. Plaintiffs alleged that the consequent flooding destroyed crops, equipment, and infrastructure, and also deposited substantial quantities of sand and gravel that impair farming and cause recurring flooding from rain. Although the United States had acquired flood easements in the past from some landowners, the plaintiffs alleged that the flooding here exceeded what had been provided for in the easements. In a careful opinion, Judge Firestone applied existing precedent to dismiss the claim under Rule 12(b)(6), finding that the flooding did not amount to taking because, even accepting that it reflected deliberate government policy, it was based on a single flooding incident. The court followed precedent providing that flooding attributable to the government amounts to taking only if it is both intentional and either permanent or "intermittent but inevitably

90. 33 U.S.C. § 702c (2006) ("No liability of any kind shall attach to or rest upon the United States for any damage from or by floods or flood waters at any place . . . ."). *See* United States v. James, 478 U.S. 597, 608 (1986) ("Congress clearly sought to ensure beyond doubt that sovereign immunity would protect the Government from 'any' liability associated with flood control."), *abrogated by* Cent. Green Co. v. U.S., 531 U.S. 425 (2001).

91. *E.g.*, *In re* Katrina Canal Breaches Consol. Litig., 647 F. Supp. 2d 644 (E.D. La. 2009), *rev'd*, Nos. 10-30249, 10-31054, 11-30808, 2012 WL 4343775 (5th Cir. 2012). The earlier decision is thoughtfully critiqued in Edward P. Richards, *The Hurricane Katrina Levee Breach Litigation: Getting the First Geoengineering Liability Case Right*, 160 U. PENN. L. REV. 267 (2012).

92. *See, e.g.*, Sanguinetti v. United States, 246 U.S. 146, 149–50 (1924).

93. No. 11-275L, 2012 WL 1570878 (Fed. Cl. May 4, 2012).

recurring."[94] Plaintiffs argued that the flooding they suffered was inevitably recurring because the Corps's operation plan for the river directed it to breach the levee and flood Birds Point whenever river conditions met established standards. The court rejected this argument based upon another precedent providing that planned flooding can be a taking only if plaintiffs can show that it caused more frequent flooding than would have occurred in the plan's absence.[95] As the Supreme Court stated long ago, "The Government has not subjected respondent's land to any additional flooding, above what would occur if the Government had not acted; and the Fifth Amendment does not make the Government an insurer that the evil of floods be stamped out universally before the evil can be attacked at all."[96] Allegations that the plan created more damaging—though not more frequent—flooding did not suffice.[97]

Big Oak Farms demonstrates the formidable doctrinal defenses that courts have provided the United States against flooding-related takings claims based upon flood-control efforts. The Supreme Court has not seriously considered flooding takings in many decades. In that time, general takings law has developed substantially, with a conservative plurality eager to establish greater constitutional protections for private property.[98] The Court has now granted certiorari in a flooding case, *Arkansas Game and Fish Commission v. United States,* in which the Federal Circuit found no taking because flooding was considered temporary when Corps officials temporarily flooded a state forest during growing season for six consecutive years.[99] Given the Court's enhanced interest in so-called temporary takings over the past two decades, there is a substantial chance that the Court will expand takings liability for flooding.[100] Although prior cases seem to have established a per se rule that temporary, nonrecurring floods cannot be takings, it would be surprising if the Court should adhere to that perspective. The Government may be satisfied if the Court holds only that temporary flooding should be evaluated under the fact-

94. *Id.* at *3 (quoting United States v. Cress, 243 U.S. 316, 328 (1917)). *See also* Ridge Line, Inc. v. United States, 346 F.3d 1346 (Fed. Cir. 2003).

95. *Big Oak Farms*, 2012 WL 1570878, at *8.

96. United States v. Sponenbarger, 308 U.S. 256, 266 (1939).

97. *Big Oak Farms*, 2012 WL 1570878, at *8.

98. *See generally* J. Peter Byrne, *Ten Arguments for the Abolition of the Regulatory Takings Doctrine*, 22 ECOLOGY L.Q. 89 (1995).

99. Ark. Game & Fish Comm'n v. United States, 637 F.3d 1366, 1367 (Fed. Cir. 2011), *cert. granted*, 132 S. Ct. 1856 (2012).

100. *See* Tahoe–Sierra Pres. Council v. Tahoe Reg'l Planning Agency, 535 U.S. 302 (2002); First English Evangelical Lutheran Church v. Cnty. of L.A., 482 U.S. 304 (1987).

sensitive *Penn Central* test, rather than treating intentional or foreseeable flooding as a physical occupation amounting to a per se taking.[101] The argument seems strong because a per se taking rule threatens to erode the distinction between takings and torts. Because some of the Justices desire to extend constitutional protections for private property, this case will likely mandate more frequent government liability for intentional flooding.

What does that indicate about takings liability for government armoring of the coast? The current round of river flooding cases may well provide the normative context within which government management of seawalls to hold back rising seas will be viewed. Government will be unable to erect levees everywhere rising seas should threaten land. Choices will need to be made based on feasibility, cost, and environmental consequences. Losers are likely to argue that deliberate choices not to protect their property should entitle them to compensation in a manner analogous to property owners whose lands are flooded when seawalls to protect others are erected or destroyed. Government cannot take property purely by inaction. But extensive plans for seawalls that exclude certain private parcels may be viewed by courts as a more active decision to flood those parcels, especially if the armoring increased the magnitude of the flood risk to intentionally unprotected land. Also, more severe storms assaulting seawalls and levees will likely result in more occasions in which the government must decide whether to breach works and flood one area to protect another. Floods that would be attributed to nature against a background of government inaction may be charged against government when it acts to manage them.[102] The distracting issue of temporary flooding may play a smaller role in sea-level rise flooding disputes because sea-level rise inundation will be permanent in the legal sense (although stronger storm surges reaching farther inland will still present temporary flooding puzzles).

Property rights advocates can place government decisions to permit flooding of specific private land into the traditional narrative of takings cases. Once government assumes from Nature the authority to decide who shall be flooded and who shall be defended, flooded property owners will claim a right to compensation. These property owners will invoke maxims stressing that landowners whose lands are sacrificed for the general good are bearing "public burdens which, in all fairness and justice,

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101. *See* Brief for Respondent at 37–41, Ark. Game & Fish Comm'n v. United States, 132 S. Ct. 1856 (2012) (No. 11-597).

102. *See* JOHN MCPHEE, THE CONTROL OF NATURE (1989).

should be borne by the public as a whole."[103] Moreover, the government's discretion to choose whom and where to flood may raise the same concerns about the political influence of the wealthy and powerful that have animated opposition to eminent domain. In short, sea-level rise may make government decisions about whether to armor someone's property subject to takings claims to a degree similar to what the U.S. Supreme Court may prescribe for deliberate decisions to flood some land to protect or benefit other land. Such an approach could seriously deter decisions to retreat in the face of sea-level rise rather than to build levees because the government would need to compensate owners for the permitted inundation of their land.

Several powerful doctrines stand in the way of this dangerous path. The Court has squarely ruled that government-caused flooding does not give rise to a taking if the subject land would have flooded under natural conditions.[104] This rule would surely protect government decisions not to armor shorelines, but it arose at a time of greater judicial confidence in the benefits of government management of resources. How it fares in upcoming rounds of flooding litigation remains to be seen.

At bottom, government liability to property owners for flooding from management of government water-control facilities raises fundamental issues about the government's role in addressing environmental risks. These more foundational issues are somewhat reflected in the case law. Long-established precedent provides that when government must choose which entities will suffer an unavoidable loss from a natural calamity, it does not incur takings liability to the loser.[105] As the Court wrote in upholding a Virginia law requiring the destruction of infected cedar trees in order to save more valuable apple trees: "When forced to such a choice the [government] does not exceed its constitutional powers by deciding upon the destruction of one class of property in order to save another which, in the judgment of the legislature, is of greater value to the public."[106] Similarly, the courts have recognized an emergency exception to normal takings liability for government "destruction of 'real and personal property, in cases of actual necessity, to prevent the spreading of a fire' or to forestall other grave threats to the lives and property of

103. Armstrong v. United States, 364 U.S. 40, 49 (1960).
104. United States v. Sponenbarger, 308 U.S. 256, 265–66 (1939).
105. Miller v. Schoene, 276 U.S. 272 (1928).
106. *Id.* at 279.

others."[107] These doctrines have somewhat stood on the fringes of regulatory takings doctrine because giving them full effect would come close to abolishing any normative foundation for regulatory takings generally. Sea-level rise may bring them to the center of consideration because government will be addressing a widespread, if slow-moving, calamity that will require choosing between where to flood and where to protect over a vast area. While it is too early to predict how courts will resolve this fundamental problem, it should sharpen the interest in how the Supreme Court conceptualizes takings by deliberate flooding.

B. Soft Armoring

Soft armoring, such as beach or wetlands restoration, harms environmental resources less than does hard armoring, because soft armoring aims to preserve or mimic natural landscape features and to preserve their ecological services. When successful, beach and dune replenishment can provide barriers against storm surges and rising seas, while engineered wetlands can also protect against storms while creating habitat and cleaning polluted waters.[108] To be sure, such efforts are not always successful and thus pose greater environmental risks than retreat. Moreover, such efforts can be extremely expensive. Congress appropriated more than $100 million each year between 1997 and 2005 for beach restoration.[109] The demand for beach renewal is likely to increase due to sea-level rise and associated storm-driven erosion. Yet, the public has shown a willingness to bear some costs for soft armoring to preserve recreational beaches. Also, private developers have engineered new wetlands as required mitigation for permits to fill and develop other wetlands.[110]

Soft armoring presents different takings problems from hard armoring. It does not hold back walls of water and will not be breached intentionally to manage rising waters. Beach replenishment does raise questions about ownership of the newly constructed beach. Statutes authorizing beach renourishment, such

107. Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1029 n.16 (1992) (quoting Bowditch v. City of Boston, 101 U.S. 16, 18 (1880)).

108. *See* Verchick & Scheraga, *supra* note 80, at 18.

109. OFFICE OF SENATOR TOM COBURN, WASHED OUT TO SEA: HOW CONGRESS PRIORITIZES BEACH PORK OVER NATIONAL NEEDS 11 (2009), *available at* http://www.coburn.senate.gov/public/index.cfm?a=Files.Serve&File_id=e12c6935-f034-4d9e-b7b3-093cf98a4ff9.

110. *See Compensatory Mitigation*, U.S. ENVTL. PROT. AGENCY, http://water.epa.gov/lawsregs/guidance/wetlands/wetlandsmitigation_index.cfm (last updated Oct. 9, 2012).

as the Florida statute considered below, understandably provide that the public owns the new beach that it has paid to create, but littoral owners may complain either that they should own the new beach or that their riparian rights related to contiguity to the water have been eliminated.

The Supreme Court may have provided a roadmap for local governments to conduct beach restoration without takings liability in its unanimous decision in *Stop the Beach Renourishment v. Florida Department of Environmental Protection*.[111] In that case, the Court upheld a decision of the Florida Supreme Court, which had upheld a statutorily prescribed beach restoration initiative against takings challenges by littoral owners. The statute provided that a restored beach would be public property and that the boundary of the upland littoral owner would be fixed at an historic mean high-tide line rather than moved seaward to the new-shifting mean high-tide line.[112] The upland owners argued in the state courts that the Act deprived them of the rights to future accretions and to have their land touch the water, but the Florida Supreme Court held that the upland owners did not have common law riparian rights of the dimension they claimed.[113] The U.S. Supreme Court subsequently granted certiorari to determine whether the state court's alleged change in common law property rules can effect a taking requiring the payment of just compensation.[114] Nonetheless, the Supreme Court upheld the Florida Court's decision because it considered the beach restoration to be an avulsion under state law (rather than an accretion), which did not move the boundary and which effectuated under common law a separation of the upland owner from contact with the water.[115] Accordingly, the statute did not work a taking because it mimicked the effect of the common law.

Courts have taken *Stop the Beach* as a green light to sustain beach renourishment programs against takings claims.[116] After all, such projects dump dredged sand on public trust sea bottoms, seaward of the tideline, so that no current private dry land is appropriated or even necessarily trespassed upon. States are

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111. 130 S. Ct. 2592 (2010).

112. Dennis L. Jones Beach and Shore Preservation Act, ch. 61-246, 1961 Fla. Laws (codified as amended at FLA. STAT. §§ 161.011–.45 (Westlaw 2012)).

113. Walton Cnty. v. Stop the Beach Renourishment, Inc., 998 So. 2d 1102 (Fla. 2008), *aff'd sub nom*. Stop the Beach Renourishment, Inc. v. Fla. Dep't of Envtl. Prot., 130 S. Ct. 2592 (2010).

114. *See* J. Peter Byrne, *Stop the* Stop the Beach *Plurality!*, 38 ECOLOGY L.Q. 619 (2011).

115. *Id.* at 634.

116. *See, e.g.*, City of Long Branch v. Jui Yung Liu, 4 A.3d 542 (N.J. 2010).

unlikely to fund beach reconstruction projects if the new beaches are constitutionally required to be privately owned.[117] Furthermore, states are unlikely to fund beach restoration projects if states are forced to compensate private land owners when appropriating their land for public use. If courts can deem the construction "avulsion" rather than "accretion," the upland owner's common law rights are not at all impaired.

Yet, the doctrine of avulsion seems a slim reed upon which to rest such large-scale public projects. Although ancient and ubiquitous, the avulsion–accretion distinction rests on weak normative grounds.[118] It is difficult to understand why property rights should depend on the speed and perceptibility with which a water boundary recedes or encroaches. Moreover, the distinction seems quite susceptible to judicial interpretation to reach desired results post-hoc, as the degree of perceptibility necessary for finding avulsion cannot be stated with any precision. Indeed, it may be the best rationale for the distinction that its vagaries allow courts to accomplish substantial justice post-hoc.[119]

Application of the common law doctrines of accretion and avulsion to beach reconstruction raises additional concerns, particularly in the era of sea-level rise. The traditional normative rationales for the doctrines of accretion and avulsion rest on the expectation that natural forces will unpredictably change water boundaries in both directions. Thus, accretion often is justified by the belief that a littoral or riparian owner will sometimes gain land and will sometimes lose land as lands erode or accrete. Blackstone wrote that "owners, being often losers by the breaking in of the sea, or at charges to keep it out, this possible gain is therefore a reciprocal consideration for such possible charge or loss."[120] Similarly, sudden storms will sometimes perceptibly shift lands in either direction. But beach reconstructions are planned, financed, and engineered projects in which officials must take into account *ex ante* what effects their construction will have upon boundaries. Normative justifications for such projects should provide an overall assessment of their reasonableness and distributional

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117. The Texas General Land Office has refused since the decision in *Severance v. Patterson*, 370 S.W.3d 705 (Tex. 2012), to fund future erosion projects in West Galveston Bay because "[p]ublic money cannot be used to benefit only a private land owner." Jerry Patterson, Commissioner, Severance v. Patterson: *Frequently Asked Questions*, TEX. GEN. LAND OFFICE, http://www.glo.texas.gov/what-we-do/caring-for-the-coast/_documents/open-beaches/faq-openbeaches.pdf (last visited Oct. 11, 2012).

118. *See supra* notes 54–55 and accompanying text.

119. *See* Sax, *supra* note 49, at 344–45.

120. 2 WILLIAM BLACKSTONE, COMMENTARIES *262.

consequences rather than an invocation of obscure common law distinctions. Moreover, despite short-term fluctuations due to erosion and reliction, sea-level rise will move boundaries in only one direction: inland. The accretion rule must forfeit its traditional claim to fairness when boundaries no longer are as apt to move in one direction as in the other.[121]

Courts' consideration of regulatory takings claims for beach reconstruction may cling for a time to the mask of avulsion but over time needs to take a more comprehensive view of whether the effects on upland owners are the types of losses they should bear in all "fairness and justice."[122] Such renourishment, after all, protects the upland owner from erosion and from sea-level rise. No takings liability should attach to beach reconstruction so long as deprivation of upland owners' rights is no greater than necessary to accomplish the project. The Florida Beach and Shore Preservation Act guarantees littoral owners that they will have access to the water, that no permanent structures will be erected on the new beach, and that the moving boundary line will resume if the state fails to maintain the reconstructed beach.[123] As Justice Scalia stated at oral argument in *Stop the Beach*, "I'm not sure it's a bad deal."[124] The Takings Clause should not require something other than that.

C. Retreat

The environmental and economic arguments for retreat before sea-level rise are compelling, at least for many coastal areas not intensely developed.[125] As noted above, sea-level rise presents a problem primarily because of real estate development and predictable efforts to defend it. Preventing or removing development in the zone at risk for sea-level rise will reduce public costs of defending or responding to crises and will permit natural landscape features providing valuable ecological services to migrate landward. Different levels of stringency will be

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121. Away from the open seas, climate change will cause droughts that may move boundaries formed by rivers and lakes in different directions.

122. Armstrong v. United States, 364 U.S. 40, 49 (1960).

123. FLA. STAT. § 161.201 (Westlaw 2012).

124. *Stop the Beach Renourishment, Inc. v. Florida Department of Environmental Protection*, THE OYEZ PROJECT AT IIT CHICAGO-KENT COLLEGE OF LAW, http://www.oyez.org/cases/2000-2009/2009/2009_08_1151 (follow "Stop the Beach Renourishment Inc. v. Florida Department of Environmental Protection - Oral Argument" hyperlink; then follow "Full Transcript Text" hyperlink) (last visited September 10, 2012).

125. *See* Byrne & Grannis, *supra* note 10.

appropriate for different areas, depending on their current and planned levels of development, their foreseeable proximity to rising waters, their suitability for hosting future ecological services as natural features seek to migrate, and other appropriate planning considerations.

Most land-use regulations are devised and implemented by local governments pursuant to delegated state authority.[126] Many states have created state-level agencies to plan and regulate land use near the coasts. The divisions of authority between localities and states in coastal areas can create complex problems of legal authority.[127] Nonetheless, states and their localities have ample authority to implement regulations to address sea-level rise.[128] Land-use regulations can mandate or encourage retreat of development by prohibiting, limiting, or conditioning new development or rebuilding.

Efforts to enact such regulations will surely be resisted politically by those whose property or investments are harmed by them, as well as by local governments dependent on increased real estate taxes in the short term. Threats of takings liability will influence legislative decisions. Also, private property owners losing in the political process will likewise press regulatory takings claims. Part II.C considers existing law as it relates to various regulatory approaches to retreat and also discusses several means for governments seeking to effectuate retreat to avoid or limit takings liability.

Lucas v. South Carolina Coastal Council is the touchstone for considering the regulatory takings consequences of retreat regulation.[129] While that well-known and perennially controversial decision has been whittled down in direct application by subsequent decisions, it has shaped beachfront regulation in the face of sea-level rise. In *Lucas*, South Carolina's Beachfront Management Act of 1988 attempted to implement a retreat strategy in response to past storm damage and studies of future sea-level

126. *See* Vill. of Euclid v. Ambler Realty Co., 272 U.S. 365 (1926) (describing and upholding against constitutional challenge traditional local zoning); Rapanos v. United States, 547 U.S. 715, 738 (2006) ("Regulation of land use . . . is a quintessential state and local power.").

127. Recent examples of state legislation addressing sea-level rise include Maryland's Living Shoreline Protection Act of 2008, MD. CODE ANN., ENVIR. § 16-201 (Westlaw 2012), and Connecticut's Act Concerning the Coastal Management Act and Shoreline Flood and Erosion Control Structures, S.B. 376, 2012 Reg. Sess. (Conn. 2012), *available at* http://www.cga.ct.gov/2012/act/pa/2012PA-00101-R00SB-00376-PA.htm (last visited Sept. 10, 2012). Both statutes, *inter alia,* transfer authority over armoring from local to state control.

128. GRANNIS, *supra* note 10, at 1.

129. 505 U.S. 1003 (1992).

rise.[130] One technique was scientifically sound but politically risky: it prohibited the construction of permanent structures seaward of a line drawn to reflect the most landward tidelines over the past 40 years.[131] As a result of this enactment, David Lucas found himself the owner of two undeveloped beachfront lots upon which no house could be built even though his lots were surrounded by large, expensive houses. A state trial court held that the statute effected a taking of Lucas's property because he retained no economically viable use for the lots. The South Carolina Supreme Court never addressed this factual conclusion because it rejected Lucas's takings claim on the ground that it was a reasonable environmental measure designed to protect the public from harm. The U.S. Supreme Court rejected the South Carolina Supreme Court's legal reliance on the prevention of environmental harm and held that the Beachfront Management Act effected a taking per se because it left the owner with no economic value in the property.

Justice Scalia's opinion for the Court in *Lucas* has been analyzed many times from many perspectives. Certainly, it attempted to draw a line in the sand by stating that any restriction on use that leaves an owner with no economic value is the equivalent of expropriation without regard to its purpose or public benefits unless the restriction merely duplicated use restrictions already inherent in the title. This rule made bans on new construction constitutionally impracticable, regardless of the environmental benefits, unless some property law justification, such as nuisance law, could be found to restrict the owner's normal development rights. Nuisance law has provided a very limited justification for regulations preventing environmental harm because it is premised on harm to identifiable property owners, whereas environmental harm injures widely diffused populations.[132] Other harms from coastal development similarly injure the broader community, by increasing the costs of responding to natural disasters, such as hurricanes, and maintaining infrastructure worn down by wind and water.

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130. *See* Vicki Been, Lucas *v. the Green Machine: Using the Takings Clause to Promote More Efficient Regulation?*, *in* PROPERTY STORIES 299, 307–08 (Gerald Korngold & Andrew P. Moriss eds., 2d ed. 2009).

131. The Act also included more flexible provisions regulating new construction in a "setback zone" calibrated on an extension of current erosion rates in order to regulate in an area where dunes were expected to migrate over the next 40 years. Such a rolling development restriction is considered at greater length below. *See infra* notes 172–79 and accompanying text.

132. *See* Jeff L. Lewin, Boomer *and the American Law of Nuisance: Past, Present, and Future*, 54 ALB. L. REV. 189, 229–30 (1990).

On its face, *Lucas* presents a formidable barrier to land-use regulations implementing a retreat strategy because it mandates compensation for total prohibitions on development even if justified by the need to protect the shoreline ecology. Subsequent decisions more sympathetic to environmental regulation have focused both on limiting the scope of *Lucas*'s application and on expanding the scope of its exception for limitations that inhere in the owner's title. First, the scope of *Lucas* has been confined largely to its facts, which depend upon the implausible but unchallenged trial court finding that the regulations deprived the owner's lots of all of their economic value.[133] The Supreme Court's decision in *Tahoe–Sierra* made it clear that *Lucas* applies only to regulations that effect an 100% destruction in economic value.[134] Thus, special subdivision or zoning regulations for shore areas that permit only very few clustered structures on large lots do not invoke *Lucas* and will be evaluated under the more contextual approach of *Penn Central,* where the economic loss to the property owner will be viewed in light of the public need for retreat.[135]

Second, although nuisance law to date has contributed little to taming *Lucas*, the public trust doctrine has contributed more. As noted above, the public trust secures public ownership or (in some states) an easement over lands beneath navigable waters and tidelands. The public trust inheres in title to land.[136] Accordingly, it defeats private owners' regulatory takings claims against the

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133. Among other things, the U.S. Supreme Court refused to consider the effect on the takings analysis of the variance procedures added to the Act after the trial court's decision, apparently straining to reach its categorical holding. *See Lucas,* 505 U.S. at 1014 n.5.

134. Tahoe–Sierra Pres. Council, Inc. v. Tahoe Reg'l Planning Agency, 535 U.S. 302, 332 (2002) ("In fact, these cases make clear that the categorical rule in Lucas was carved out for the 'extraordinary case' in which a regulation permanently deprives property of all value; the default rule remains that, in the regulatory taxing context, we require a more fact specific inquiry.").

135. Land-use regulations to adapt to sea-level rise that do not fall into the *Lucas* category are quite likely to be upheld. Courts have been supportive of land-use regulations addressing flooding risks because they promote safety. *See, e.g.*, First English Evangelical Lutheran Church v. Cnty. of L.A., 258 Cal. Rptr. 893 (Cal. Ct. App. 1989). They have also embraced regulations based on the future effects of climate change in several legal contexts. *See, e.g.*, *In re* Polar Bear Endangered Species Act Listing & § 4(d) Rule Litig., 794 F. Supp. 2d 65 (D.D.C. 2011) (upholding agency listing of polar bears as a threatened species despite scientific uncertainty). *Cf.* Massachusetts v. EPA, 549 U.S. 497 (2007) (holding that scientific uncertainty did not excuse EPA from regulating greenhouse gas emissions).

136. Hope M. Babcock, *Should* Lucas v. South Carolina Coastal Council *Protect Where the Wild Things Are? Of Beavers, Bob-O-Links, and Other Things That Go Bump in the Night*, 85 IOWA L. REV. 849 (2000).

application of development regulations to projects within public trust areas.[137] Moreover, it will move landward with the tideline. Thus, as the seas rise and the public trust areas move upland, the use rights of owners will either be extinguished or subjected to public property interests that will permit strict regulation without regard to *Lucas.* Note that when the public trust applies, the private owner is not just relegated to *Penn Central* but has no takings claim at all because the public enjoys a superior property interest.

The contours of the public trust doctrine are vague, and some courts have substantially expanded the resources to which it applies, as well as the public uses and values that it protects.[138] A key question is whether the proximity of private land upland to public trust land and its anticipated conversion by accretion enhances regulatory authority under the Takings Clause. In other words, does the fact that a regulation seeks to restrict private land in order to protect nearby or future public land limit the private owner's right so that such restrictions would not be held to be regulatory takings although they would be in another landscape?[139] On one hand, courts are unlikely to extend full public trust rights to new categories of uplands now privately owned because doing so would largely displace most private rights. Unless the court finds that the public trust inheres in the private owner's title, it cannot save a regulation that otherwise falls within the *Lucas* category. On the other hand, the arguments that regulation of private land protects nearby public trust resources and that those private lands likely will become public through accretion in the foreseeable future must be powerful factors to consider under a *Penn Central* analysis. These considerations add protection of the public's ownership interests to police power protection of public health, safety, and welfare.

Another approach to accomplishing retreat is a prohibition against armoring portions of the coastline.[140] This Article has already considered land-use regulations that directly prohibit or

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137. *See* McQueen v. S.C. Coastal Council, 580 S.E.2d 116 (S.C. 2003); Esplanade Props., LLC v. City of Seattle, 307 F.3d 978 (9th Cir. 2002) (holding that the city's denial of an owner's application to develop property in tidelands did not effect an unconstitutional taking).

138. *See, e.g.*, Avenal v. State, 886 So. 2d 1085 (La. 2004); Klass, *supra* note 45, at 708–13.

139. *See* Peloso & Caldwell, *supra* note 11, at 69–82.

140. *See* GRANNIS, *supra* note 10, at 36–40. Prohibitions on armoring will likely achieve a more haphazard retreat than planned regulatory retreat with more human distress and less environmental benefit, but they may be more politically acceptable because they highlight nature's role in forcing retreat more than law.

restrict development in coastal areas. Prohibitions on building bulkheads and other engineering defenses against sea-level rise also implement a retreat strategy because without armoring, rising waters and storm erosion will eventually compel owners to retreat as properties become inundated or unsafe. Such prohibitions also address harms that armoring can impose on natural shorelines by exacerbating lateral erosion or by eliminating the intertidal area.

A number of states already prohibit armoring on the oceanfront, and so far these have survived takings challenges. For example, North Carolina's state-level regulation prohibiting construction of hardened structures for erosion control on the state's beaches was upheld.[141] Such a result makes sense. Armoring prohibitions generally do not deprive the owner of all economically valuable use so long as the threat of erosion or inundation remains in the future. Current use of previously developed land is preserved. Thus, except in exigent circumstances, the regulation should be analyzed under *Penn Central*, where the importance of accommodating natural shoreline changes and the harm to other shore lands can be considered. Moreover, future losses to the owner will be accomplished by nature, not by government; the owner is prohibited only from taking defensive measures that have adverse effects on neighbors, on the environment, and on public trust resources.[142]

This orthodox analysis is threatened to some extent by the Supreme Court's flirtation with the alternative standard, which looks to determine if a statute or court decision has eliminated an established property right. The plurality opinion in *Stop the Beach Renourishment* embraced this test for so-called judicial takings. The plurality stated that any judicial change in common law property rules that eliminated an established right constitutes a taking.[143] Some prior decisions tend toward adopting this same approach without much discussion.[144]

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141. *See* Shell Island Homeowners Ass'n, Inc. v. Tomlinson, 517 S.E.2d 406 (N.C. Ct. App. 1999).

142. In *United States v. Milner*, 583 F.3d 1174 (9th Cir. 2009), the court held that an ordinance prohibiting seawalls did not effect a taking, noting that it protected tribal rights in tidelands.

143. Stop the Beach Renourishment, Inc. v. Fla. Dep't of Envtl. Prot., 130 S. Ct. 2592, 2602 (2010) ("If a legislature or a court declares that what was once an established right of private property no longer exists, it has taken that property, no less than if the State had physically appropriated it or destroyed its value by regulation.").

144. *See* Phillips v. Wash. Legal Found., 524 U.S. 156, 160 (1998) (holding that interest payments upon a deposit must be assigned to the owner of the principal).

Adherence to such an approach would essentially prevent legislatures in some states from prohibiting armoring without compensation to owners. Under the common law "common enemy rule" followed with various refinements in some states, a land owner can take any steps required to fend off casual waters, including flood waters, without regard to the damage to others.[145] In such a state, a statutory prohibition on armoring would deprive an owner of a common law right. Thus, a full-blooded application of the plurality from *Stop the Beach* would appear to constitute a taking because it eliminates an established common law right.[146] Other states follow a "reasonable use rule" under which landowners who divert floodwaters will not be liable unless the resulting interference with another's land is unreasonable. In such states, the statutory prohibition on armoring could be found a taking unless the court concludes that the statute fits within the common law rule by protecting other landowners, including public trust lands.

Such outcomes highlight the radical nature of the common law essentialism that the plurality in *Stop the Beach* embraced.[147] Statutes are adopted to change common law rules in light of experience and political judgment, but this approach makes the State compensate loser property owners when making changes deemed to eliminate established property rights. Such an approach excessively canonizes the status quo and creates a bulwark against experiment and reform. Moreover, it goes against Supreme Court precedent. For example, a virtually unanimous Court upheld a statutory prohibition on sale of eagle parts, stating, "[T]he denial of one traditional property right does not always amount to a taking. At least where an owner possesses a full 'bundle' of property rights, the destruction of one 'strand' of the bundle is not a taking, because the aggregate must be viewed in its entirety."[148] The Court has repeatedly emphasized that it looks at the property as whole,

145. *See generally* Davis, *supra* note 83 (describing the different approaches among the states to diffused surface water).

146. Under the *Stop the Beach* plurality's approach, classic state common law decisions changing from the common enemy to the reasonable use approach, such as *Wisconsin v. Deetz*, 224 N.W.2d 407 (Wis. 1974), and *Tucker v. Badoian*, 384 N.E. 2d 1195 (Mass. 1978), constitute judicial takings because they deprive one owner of an established property right to divert water without liability. And eventually, someone will argue that such a change in the common law is not just a taking but is constitutionally invalid because it takes a right from A and gives it to B and therefore lacks a public use.

147. *See* Byrne, *supra* note 114.

148. Andrus v. Allard, 444 U.S. 51, 65–66 (1979).

weighing the facts of the case to determine whether fairness requires that the owner be compensated.[149]

Prohibitions on armoring may crystallize divergent paths in the development of regulatory takings doctrine. The pathway of common law essentialism would make efforts to adapt to climate change dependent on adhering to common law doctrines adopted without regard to modern science or environmental conditions, potentially hamstringing innovations.[150] Moreover, the common law rules implicated by sea-level rise contain a myriad of obscure rights for littoral owners, such as rights of unobstructed view, categorical constitutional protection of which would severely constrain regulators. The other pragmatic path, while hardly unproblematic, does reserve constitutional compensation for property owners unfairly burdened by large losses not reasonably foreseeable at the time of their investment.

There is yet another, more obscure branch of regulatory takings doctrine that may constrain an otherwise rational retreat strategy. A long-standing, if vague and under-theorized, body of law provides that government's failure to maintain public access can effectuate a taking of the marooned property.[151] Thus, a decision not to rebuild roads or bridges threatened by rising seas or more severe or more frequent storms can trigger a constitutional duty to compensate owners losing access to the public road system.[152] The paucity of decisions, mostly in lower state courts, and the brief, precedent-minded opinions make it difficult to predict how vigorous a constraint this might be for a locality facing mounting costs for damaged or threatened infrastructure.

The problem can be observed by considering a decision of a Florida state court of appeals.[153] In *Jordan v. St. Johns County*, property owners on a barrier island alleged an inverse condemnation because St. Johns County, Florida, had intentionally failed to maintain the sole access road, which was "subject to repeated damage from natural forces such as storms and

149. *See, e.g.*, Keystone Bituminous Coal Ass'n v. DeBenedictis, 480 U.S. 470, 497–99 (1987).

150. *See* Byrne, *supra* note 59.

151. *See* William B. Stoebuck, *The Property Right of Access Versus the Power of Eminent Domain*, 47 TEX. L. REV. 733 (1969).

152. *See* David A. Lewis, *Constitutional Property Law Analysis of State and Local Government Disinvestment in Infrastructure as a Coastal Adaptation Strategy* (2012) (unpublished student paper) (on file with author); Travis Martay Brennan, *Redefining the American Coastline: Can the Government Withdraw Basic Services From the Coast and Avoid Takings Claims*?, 14 OCEAN & COASTAL L.J. 101 (2008).

153. Jordan v. St. Johns Cnty., 63 So. 3d 835 (Fla. Dist. Ct. App. 2011).

erosion."[154] The appeals court reversed the trial court's grant of summary judgment to the County, ruling that a "governmental entity has a duty to reasonably maintain its public roads."[155] Moreover, the failure of the government to act in the face of this duty "can support a claim for inverse condemnation."[156] The court relied on prior decisions of the Florida Supreme Court dealing with road reconstruction eliminating access to the public highway. "There is a right to be compensated through inverse condemnation when governmental action causes a substantial loss of access to one's property even though there is no physical appropriation of the property itself."[157]

Such an approach, if courts vigorously pursue it, could severely hamstring reasonable government planning for retreat, even in the absence of regulation of private property uses.[158] This judicially-created doctrine may have made sense in light of an owner's normal reliance on public access for his or her land and concerns about government discrimination, but such rationale is greatly diminished in the shadow of sea-level rise. Plainly, government must discontinue providing access to parcels rendered uninhabitable by water. Nor should government be expected to fund rehabilitation of public ways at unlimited expense to elevate roads above wet land. Those points being granted, a court should defer to government's reasonable judgments that sea-level rise has rendered maintenance of a public roadway unsafe or economically imprudent. Judge-made doctrines to protect property owners under normal conditions should not be extended to provide inflexible protections under changed environmental conditions.

III. THE TEMPORAL DIMENSION

A characteristic of our property law is its accommodation of changes in ownership and ownership rights over time. In particular, it allows legal measures presently enacted or granted to change rights in the future. The system of estates in land and future interests that English common law created has pioneered

154. *Id.* at 837.
155. *Id.* at 839.
156. *Id.*
157. *Id*. (quoting Palm Beach Cnty. v. Tessler, 538 So. 2d 846, 849 (Fla. 1989)).
158. The Coastal Barrier Resources Act prohibits the federal government from providing federal funds for constructing roads, docks, or new infrastructure on undeveloped barrier islands. 16 U.S.C. § 3504 (2006). Its prospective character insulates it from the removal of public access doctrine discussed in the text.

astounding flexibility in dividing ownership rights over time, both conditioning rights of possession or disposition and cutting them off. As previously noted, sea-level rise also raises perplexing issues of time, as society regulates land use to cope with natural forces that will impose increasing threats and eventually submerge private property. In Part II, this Article outlined several of the takings-related problems inherent in various forms of adaption land-use regulation. This Part considers the advantages that time provides to a government seeking to implement a retreat strategy through land-use regulations. This Part presents four approaches that employ time as a feature of dynamic regulation, which will avoid or minimize takings liability. Such legal measures enact regulations or take other legal actions now that will have effects primarily in the future.

As a preliminary matter, time has become a familiar element of land-use regulatory systems. Early zoning systems employed largely static approaches, under which regulation presupposed unchanging rules enacted at a single moment.[159] But growth control regulation began in the 1960s and employed dynamic models under which the permissibility of certain uses was set to change over time according to changing conditions or findings.[160] Courts largely upheld such innovations, and phased development regulations have become uncontroversial. Moreover, the core of urban land-use regulation has become site-specific legislative changes in zoning, often negotiated with the owner and accompanied by exactions to mitigate the effects or public costs of new development.[161] Even more pertinent to adaptation to climate change, many statutes, such as the federal Endangered Species Act and local historic preservation ordinances, extend new regulatory controls on private property as a result of new administrative findings, themselves often reflecting changed ecological conditions or the passage of time.[162] In short, employing time as a dynamic factor in addressing a changing natural condition seems fitting and right.

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159. For the classic example of zoning considered as one-time regulation based on end state planning, see Vill. of Euclid v. Amber Realty Co., 272 U.S. 365 (1926).

160. *See, e.g.*, Golden v. Planning Bd. of Town of Ramapo, 285 N.E.2d 291 (N.Y. 1972), *appeal dismissed*, 409 U.S. 1003 (1972).

161. *See generally* Judith Welch Wegner, *Moving Toward the Bargaining Table: Contract Zoning, Development Agreements, and the Theoretical Foundations of Government Land Use Deals,* 65 N.C. L. REV. 957 (1987).

162. *Compare* 16 U.S.C. § 1533 (2006) (listing a species as endangered or threatened), *with* D.C. CODE §6-1103(c)(3) (Westlaw 2012) (process for designating a historic landmark or historic district).

This Part focuses on using time in support of retreat regulations because retreat measures raise the most opposition from property owners as well as takings issues because in many circumstances retreat is the most cost-effective and environmentally beneficial approach. Furthermore, retreat is most easily calibrated to the passage of time. Retreat prohibits new construction in whole or in part, as well as reconstruction in sensitive areas. Yet it need not do so immediately. Moreover, some areas that may be regulated now will become publicly owned as waters rise. In general, sea-level rise would not present environmental problems if the coasts were not so heavily and ubiquitously developed because natural features and environmental services would simply move inland. The problem retreat addresses is how to allow these natural forces to operate given existing development and incentives.

Below, this Part presents and discusses four retreat measures that state or local land-use regulators may take in the near future to address sea-level rise before the its effects are felt in their entirety. To an extent, these measures seek to change regulations as needed over time so that private owners and the public can share use benefits. The goal is to allow owners to benefit while they may but also to effectively address the compelling needs to withdraw development from the advancing shoreline and permit valuable ecosystems to establish themselves in new inland locations.

Such efforts may also help shape landowners' future expectations, both allowing them to adapt economically and reducing the likelihood that courts will find regulations' application to them to constitute takings. In general, widespread discussion about the challenges of sea-level rise and long term planning to adapt to it helps government, property owners, and the public generally to understand and adjust to the changes it demands. One prominent understanding of the regulatory takings doctrine is that it protects property owners who bear disproportionate or unanticipated transition costs from changes in property law.[163] That perspective is prominent within the *Penn Central* approach, which puts at its core the frustration of reasonable "investment-backed expectations."[164] Within that understanding, embedding future restrictions in law or plans lessens surprise and permits owners to adjust or hedge against

163. Frank I. Michelman, *Property, Utility, and Fairness: Comments on the Ethical Foundations of "Just Compensation" Law*, 80 HARV. L. REV. 1165 (1967).

164. Penn Cent. Transp. Co. v. City of New York, 438 U.S. 104, 124 (1978).

those future changes, lessening the losses to them and reducing the likelihood that a court subsequently will find a taking.[165]

A. Moratorium

A moratorium temporarily prohibits new development until a planning inquiry can be conducted and a zoning regulation adopted. Moratoria are familiar if not frequent parts of the land-use planning process. The U.S. Supreme Court has written that "the consensus in the planning community appears to be that moratoria, or 'interim development controls' as they are often called, are an essential tool of successful development."[166] A moratorium has the virtue of creating time for a study of a problem or area before allowing long-lasting development to proceed. It also creates horizontal equity among potential owners contemplating development by denying an advantage to those who can quickly build before new regulations are adopted and by subjecting all to the same delay and new regulations.

A moratorium on armoring or on new development near the sea may make sense for some jurisdictions. Public consciousness about sea-level rise has only just begun, and a planning process can educate citizens about risks and alternatives. New studies about the pace of sea-level rise and its practical consequences seem to be published daily. Similarly, information about alternatives to hard armoring may enable owners to understand how to protect their property without environmental harm.[167] A moratorium could create breathing space for such planning and debate, especially if large-scale developments have been proposed that would change the shoreline before informed decisions could be made. Moratoria are more transparent and evenhanded than their near alternative,

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165. *See, e.g.*, Dist. Intown Props. Ltd. P'ship v. District of Columbia, 198 F.3d 874 (D.C. Cir. 1999) (rejecting takings claim where owner subdivided in anticipation of designation as historic landmark).

166. Tahoe–Sierra Pres. Council, Inc. v. Tahoe Reg'l Planning Agency, 535 U.S. 302, 337–38 (2002).

167. Connecticut recently enacted new legislation that minimizes the use of hard armoring in favor of enhancing natural barriers to sea-level rise (i.e., soft armoring) and placing new structures further from the shoreline. A Republican legislator and shore front property owner, who initially supported a bill more single-mindedly protective of property rights, remarked about the "living shoreline" techniques embraced by the enacted statute: "This opens it up to whole new ways to protect the shoreline; it's kind of cool. . . . I'm definitely going to take a look at it." Jan Ellen Siegel, *Coastal Management Legislation Balances Environmental Concerns with Property Rights*, CTMIRROR.ORG (May 9, 2012), http://www.ctmirror.org/story/16289/coastal-management-legislation-balances-environmental-concerns-property-rights.

informal administrative delay in granting permits until planning is completed.

A moratorium is not a per se temporary taking, even if it prohibits all development on a property for a period of time. The Supreme Court rejected such a contention in the *Tahoe–Sierra* case, where the Court held that a moratorium on development could not be considered a *Lucas* total taking for the period of the moratorium.[168] Such claims must be adjudicated under the *Penn Central* standards, by which any diminution in value to the property had to be measured against the value of the entire fee simple property interest. The Court noted that many properties will not decline in market value at all if development is postponed by a moratorium.[169] The Court emphasized that a moratorium would not countenance a "temporal severance," that is, evaluating the effects of a regulation only for the period of time in which it is in effect rather than in regard to the entire temporal span of the underlying ownership interest. A fee simple ownership interest is one of potentially infinite duration.[170]

Moratoria are generally, but not universally, permitted under state law. The key issues for courts turn on whether the moratorium was adopted in good faith for a valid planning purpose and whether the duration is reasonable in light of its purpose.[171] A moratorium adopted to plan for new land-use regulations for coastal properties should be found to have a valid purpose, given the challenge and the need to consider new forms of regulation. The problem may be how long such a moratorium may last. The complexities of sea-level rise will not presently be solved in any final way. But if a jurisdiction engages in a planning process with a definite goal and timeframe, a moratorium for that period should be held reasonable. The moratorium that survived takings review in *Tahoe–Sierra* lasted six years, not an unreasonable time given the complex task of figuring out how to permit residential development while also safeguarding the clarity of Lake Tahoe from runoff.

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168. *Tahoe–Sierra*, 535 U.S. 302.

169. *Id.* at 332 ("Logically, a fee simple estate cannot be rendered valueless by a temporary prohibition on economic use, because the property will recover value as soon as the prohibition is lifted.").

170. *Id.*

171. *See* JULIAN CONRAD JUERGENSMEYER & THOMAS E. ROBERTS, LAND USE PLANNING AND DEVELOPMENT REGULATION LAW 495–98 (2d ed. 2007).

B. Rolling Development Restrictions

Rolling development restrictions were one of the first innovative regulatory tools proposed for addressing sea-level rise. Rolling development restrictions are special zoning rules severely restricting new development or redevelopment on land near the shore. Their defining feature is that the development restrictions move landward, or "roll," as the tide line moves landward.[172] Thus, just as sea-level rise pushes the boundary between public trust tidelands and private uplands landward through accretion, the adjacent regulatory zone moves landward in front of the tideline. Instead of transferring title to the public, as the public trust doctrine does, the rolling development restriction makes applicable to land the special restrictions needed to adapt to sea-level rise as the seas draw nearer. Rolling development restrictions embody the concept of retreat, increasingly restricting development as the seas rise.

Rolling development restrictions offer property owners some substantial benefits, at least as compared with other forms of strict land-use regulation. First, they impose no regulations tailored to sea-level rise before they are needed, preserving to the owner use and development rights in the meantime. This may be especially important given the lack of certainty as to the pace of sea-level rise because rolling development restrictions would preserve the owners' rights until the seas actually begin to threaten their property. Second, despite the uncertainty concerning timing, rolling restrictions give owners certainty as to the effects of sea-level rise, allowing them to arrange their plans accordingly. The rolling feature also ties the restriction closely to the problem being addressed, making it more difficult for regulators to pursue alternative or hidden agendas in beachfront regulation.

The rolling feature, of course, helps retreat regulations pass regulatory takings review. Rolling regulations avoid the *Lucas* rule because they permit development and use now, which should have substantial economic value. Given the *Tahoe–Sierra* Court's rejection of temporal severance, the owner cannot suffer a 100% diminution in value, however strict future development restrictions may be. A court reviewing a rolling development restriction must

172. Byrne & Grannis, *supra* note 10. The clearest example of a rolling development restriction is Maine's Sand Dunes Rules, which provide that "[a] project may not be permitted if, within 100 years, the property may reasonably be expected to be eroded as a result of changes in the shoreline such that the project is likely to be severely damaged after allowing for a two foot rise in sea level over 100 years." 06-096 ME. CODE R. ch. 355, § 5 (Westlaw 2012).

consider its effect on the whole property for its full duration. For example, a beach house that will eventually become subject even to an extremely strict rolling regulation that would require the house to be abandoned would still have a substantial current-economic value based on the estimate of when sea-level rise would push the restrictive zone upon it. The key to this analysis is that the regulation applies immediately but restricts the property only when necessary to achieve the public purpose. Of course, many such private properties will become fully public when the tides cover them.

James Titus, at the U.S. Environmental Protection Agency, developed rolling development restrictions and termed the regulatory instrument a "rolling easement," invoking the easement protected under the Texas Open Beaches Act.[173] That Act protects public easements of access on Texas beaches landward of the mean high tideline created by prescription or custom; public trust tidelands lie seaward of that tideline.[174] Texas courts long interpreted public beach easements to roll landward with the tideline due to erosion or storms. Landowners upon whose land the easement rolled were required to demolish any structures that materially interfered with public access. The Texas courts repeatedly held that the rolling of the easement did not take any legal rights from the owner because the private land already had been subject to the easement and the possibility of its rolling.[175] Titus imaginatively saw this structure as providing an appropriate template for land-use regulations implementing a retreat strategy.

The Texas Supreme Court's ruling in *Severance v. Patterson* threw the template into doubt.[176] That case has a tortuous and bizarre procedural history, which need not be considered here. The sharply divided court held that a Texas beach easement does not roll without effecting a taking of an upland home, at least when the coastline moves rapidly in an avulsive event. The court's final opinion, although thoughtful, can be criticized on several grounds. But for present purposes, it must be emphasized that its takings analysis applies only to avulsion and to public access easements and not to rolling use restrictions tied to sea-level rise.

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173. Titus, *supra* note 11, at 1313.

174. TEX. NAT. RES. CODE ANN. § 61.011–61.026 (West 2011).

175. *See* Arrington v. Tex. Gen. Land Office, 38 S.W.3d 764 (Tex. App. 2001); Feinman v. Texas, 717 S.W.2d 106 (Tex. App. 1986); Moody v. White, 593 S.W.2d 372 (Tex. Civ. App. 1979); Matcha v. Mattox, 711 S.W.2d 95 (Tex. App. 1986).

176. 370 S.W.3d 705 (Tex. 2012).

First, the court made it clear that even public access easements can move by accretion without provoking a taking. The court explained:

> Although existing public easements in the dry beach of Galveston's West Beach are dynamic, as natural forces cause the vegetation and the mean high tide lines to move gradually and imperceptibly, these easements do not spring or roll landward to encumber other parts of the parcel or new parcels as a result of avulsive events.[177]

However insubstantial may be the distinction between accretion and avulsion, sea-level rise, compared with erosion from a hurricane, does move gradually and imperceptibly.

Second, and more fundamentally, the *Severance* court, following U.S. Supreme Court precedent, drew a sharp distinction between laws that authorize public access and those that regulate use. The former are always takings, while the latter are generally permissible unless they go "too far."[178] The court explicitly rejected an argument that "blurs the line between ownership and right to use of a portion of a parcel."[179] A statutory regulation, unlike a common law easement, can apply to land before the conditions that trigger different restrictions come into force. Moreover, there seems no reason why a statute creating rolling development restrictions cannot condition the rolling on sea-level rise without regard to the accretion–avulsion distinction. Because a development restriction is not a taking per se, it need not so closely adhere to rules for transferring ownership.

Thus, rolling development restrictions remain a viable and imaginative regulatory tool for implementing a retreat strategy. They preserve unimpeded current use to the private owner while immediately imposing a legal burden on the property that in the future will significantly restrict use rights. They neither authorize public access nor completely eliminate all economic value, so they are not takings per se. Considered under *Penn Central*, they preserve substantial economic value while shaping the owner's expectations long before significant limitations on use become enforceable. While not every rolling development restriction will

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177. *Id.* at 372.

178. *See* Tahoe–Sierra Pres. Council, Inc. v. Tahoe Reg'l Planning Agency, 535 U.S. 302, 326 (2002); *Severance*, 370 S.W.3d at 725 ("To say that the appropriation of a public easement across a landowner's premises does not constitute the taking of a property interest but rather . . . 'a mere restriction on its use,' . . . is to use words in a manner that deprives them of all their ordinary meaning." (quoting Nollan v. Cal. Coastal Comm'n, 483 U.S. 825, 831 (1987)).

179. *Severance*, 370 S.W.3d at 726.

survive regulatory takings review under current law, most drafted with an eye to *Penn Central* should. Such temporally flexible instruments make a virtue of the challenge inherent in sea-level rise—that we must carefully plan now for risks that will only materialize in the uncertain future.

C. Exactions

Some regulations implementing retreat will be at high risk of being held to be takings. States have different common law traditions, different judicial politics, and some have different state constitutional takings doctrines. Moreover, the federal constitutional takings doctrine has been subject to ebbs and flows, so regulations that might have been held takings in one decade might not have been have been in another. Future presidential elections will have more influence on constitutional property rights development than will logic.

One area of regulatory takings law that has remained stable for some time is exactions. This refers to the now very familiar practice of land-use regulators granting permits for development upon the condition that the owner convey some interest in property to the public in order to mitigate public harms or costs from the development. The public can obtain interests through exactions that would violate the Takings Clause if directly appropriated. Thus, government can require a property owner to convey a public easement as a proper condition to the granting of a construction permit, even if an ordinance simply mandating such access would constitute a taking per se. The Supreme Court has adjudicated uniform constitutional standards for such exactions. First, the interest exacted must have a "logical nexus" with a legitimate public purpose. Second, the interest exacted must be "roughly proportionate" to the impact of the development.[180]

Land-use regulators should be able to use exactions to implement severe use restrictions that could not be legislated directly without incurring takings liability. For example, consider prohibitions on armoring. This Article argued above that such prohibitions normally should not be considered takings. But in a state that recognized a strong common law right to armor, it might be held to be a taking because it eliminates an established common law right. But in many cases, the concern about bulkheads is directed at future, not present, sea-level rise. Thus, if an owner seeks a permit to develop a lot that may be threatened by rising waters in the foreseeable future but is not now, the government can

180. Dolan v. City of Tigard, 512 U.S. 374 (1994); *Nollan*, 483 U.S. 825.

grant the development permit on the condition that no future armoring will be permitted. Indeed, imposing such conditions is now a consistent policy of the California Coastal Commission.[181] By hypothesis, the owner has no immediate need to armor the shore and can enjoy full use of the property for some period without such construction. Such a condition plainly and logically advances important policies protecting the natural shore and neighboring landowners. It is quite proportionate to those harms because it seeks not to prevent beneficial use now, but only when the harm will crystalize. Like rolling development restrictions, it divides use rights in time between the private owner and the public.

Many stringent regulatory policies can be implemented through exactions that could not be legislated directly. In addition to prohibitions on armoring, government might impose conditions that prohibit rebuilding after destruction from a storm, or obtain conservation easements where current wetlands may survive or where future wetlands or dunes may form. Of course, exactions work only in the context of granting development permits. That sea-level rise is a known risk that will materialize in the future invites legal instruments that are implemented now but have public value later as seas rise.

D. Eminent Domain of Future Interests

There will be properties of which government will need to take ownership in order to effectively manage retreat. These may be lands that will require active management for current or future habitat for species displaced by sea-level rise or other consequences of climate change. Also, some areas will need to be held open so that natural costal features, such as wetlands or dunes, can reconstitute themselves or be constructed there. Finally, government will need to obtain some areas to constitute infrastructure, such as roads, that the sea will destroy. Some of these lands will simply need to be purchased, either consensually or through condemnation. Of course, government need not purchase lands that will be inundated because the rules of accretion will subject them to the public trust without any need for legal action. But the preservation of valuable environmental services and public functions will require the acquisition of dry land not subject to the public trust.

Land purchase poses the serious problem of financing payment. Outright purchase of large parcels adequate to meet

181. Caldwell & Segall, *supra* note 11, at 564.

probable environmental needs will cost a great deal of money, especially in light of the many other financial needs that sea-level rise will impose on public authorities. Moreover, the public will need areas meeting specific criteria—land to serve as wetlands or to otherwise provide environmental services eliminated by rising seas. Thus, owners of suitable land will possess situational monopolies that will necessitate the use of the power of eminent domain.[182] That presents additional obstacles. Eminent domain is exceedingly unpopular and, therefore, generally avoided by elected officials.[183] The Fifth Amendment, of course, requires compensation to be paid at full market value.[184]

The temporal dimension provides a partial solution here, as well. Government can use eminent domain to condemn future interests rather than full titles or fee simples. Government needs to take possession of most of the properties at issue only in the future, although it might well need to know that it will be able to take possession of them as sea-level rise progresses. Thus, the condemnation of future interests will provide assurance of future public possession of special sites. The present market value of a future interest will be a fraction of the present value of the full fee simple interest. The longer in the future the right of possession of the future interest holder is projected, the lower the present value will be. At the same time, condemnation of future interests does not intrude as much into the interests of the private owners, who can continue to use the property beneficially for the time being, perhaps for as long as his or her life. Thus, condemnation of future interests presents a surprising win–win outcome, as compared with immediate or future condemnation of full title.

There seems to be no reason why government cannot condemn future interests in real property. Even though no judicial decision has addressed the question, there seems every reason to believe that such a power would be upheld. Nothing in the Constitution prohibits it. Statutory authorizations clearly empower both the United States and New York to take all kinds of property interests by eminent domain. The Supreme Court wrote long ago: "The taking by condemnation of an interest less than the fee is familiar in the law of eminent domain. Where formal proceedings are initiated by the party condemning, it is usual and proper to specify

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182. *See* THOMAS W. MERRILL & HENRY E. SMITH, PROPERTY: PRINCIPLES AND POLICIES 1220–21 (2007).

183. *See* J. Peter Byrne, *Condemnation of Low Income Residential Communities Under the Takings Clause*, 23 UCLA J. ENVTL. L. & POL'Y 131 (2005).

184. Just compensation "means the full and perfect equivalent in money of the property taken." United States v. Miller, 317 U.S. 369, 373 (1943).

the precise interest taken, where less than the fee."[185] One commentator has stated: "Future interests are clearly subject to being taken under the power of eminent domain, since the power has been generally held to extend to every type of interest, estate, possession, or expectancy."[186] Moreover, the federal government has used a functional equivalent for more than 40 years without serious challenge: taking an entire interest in land but permitting the owner a "reservation of use and occupancy" for life or for a number of years.

The power of eminent domain is inherent in government. The Fifth Amendment restricts this power only in requiring that it be exercised for a "public use" and that the owner receive "just compensation." Taking land for conservation purposes is doubtless a "public use."[187] Questions concerning which land or how large an interest should be taken for a public purpose lie within legislative discretion.[188] Although taking a future interest implies that government needs only to make a future use of the land, that should not eliminate the public use because a present taking for future needs is permissible. The Supreme Court itself stated: "In determining whether the taking of property is necessary for public use not only the present demands of the public, but those which may be fairly anticipated in the future, may be considered."[189] Moreover, the taking of only a future interest would counter any concern that the government would be guilty of "excess condemnation" that might not constitute a public use[190] because government would be limiting displacement of private owners to the foreseeable future when the land would be required to cope with sea-level rise.

State exercises of eminent domain are governed by state statutes. These generally do not limit the types of property interests the state may condemn. New York's Eminent Domain Procedure

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185. United States v. Cress, 243 U.S. 316, 328–29 (1917).

186. Robert L. Stoyles, Jr., *Condemnation of Future Interests*, 43 IOWA L. REV. 241, 243 (1958).

187. *See* Shoemaker v. United States, 147 U.S. 282, 298 (1893); Swan Lake Hunting Club v. United States, 381 F.2d 238, 242 (5th Cir. 1967).

188. *See* Berman v. Parker, 348 U.S. 26, 36 (1954) ("It is not for the courts to determine whether it is necessary for successful consummation of the project that unsafe, unsightly, or insanitary buildings alone be taken or whether title to the land be included, any more than it is the function of the courts to sort and choose among the various parcels selected for condemnation."); *In re* Harlem River Bridge, 66 N.E. 584 (N.Y. 1903) (Government generally prefers to take full title to land because it permits unrestricted use and necessitates no continuing relationship with the former private owner.).

189. Rindge Co. v. Cnty. of L.A., 262 U.S. 700, 707 (1923).

190. *See* City of Cincinnati v. Vester, 281 U.S. 439, 448–49 (1930).

Law, for example, broadly defines the "real property" that can be condemned to include:

> [A]ll land and improvements, lands under water, waterfront property, the water of any lake, pond or stream, all easements and hereditaments, corporeal or incorporeal, and every estate, interest and right, legal or equitable, in lands or water, and right, interest, privilege, easement and franchise relating to the same, including terms for years and liens by way of mortgage or otherwise.[191]

This language plainly includes future interests. The government's authority to take easements rather than full title is well established.[192] Indeed, courts have sometimes created a presumption that condemnation of a right of way transfers only an easement rather than a fee interest in the transportation corridor.[193] Government can also condemn temporary interests in land and leaseholds, when it suits public needs.[194]

The National Park Service (NPS) has been using condemnation to take the equivalent of future interests for many years. The Cape Cod National Seashore Act, for example, provides that when the Service seeks to condemn "improved property," essentially a single-family home and lot, the owner may "elect" to retain "the right of use and possession" for up to a 25-year term or for the owners' lives.[195] When the private owner elects to retain a life estate or term of years, NPS obtains a future interest analogous to a reversion. Current NPS policy also generally provides for similar reservations in owners of condemned lands. NPS Director's Order number 25, section 11.3, authorizes NPS to "allow a reservation of use and occupancy of property improved with a residence."[196] Thus, while some statutes require NPS to offer reservations at some sites, NPS may do so at any of its sites.[197] Under this

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191. N.Y. EM. DOM. PROC. LAW § 103 (McKinney Supp. 2012).

192. Danaya C. Wright & Jeffrey M. Hester, *Pipes, Wires, and Bicycles: Rails-to-Trails, Utility Licenses, and the Shifting Scope of Railroad Easements from the Nineteenth to the Twenty-First Centuries*, 27 ECOLOGY L.Q. 351 (2000).

193. *See* Preseault v. United States, 100 F.3d 1525 (Fed. Cir. 1996); Roby v. N.Y. Cent. & Hudson River R.R. Co., 36 N.E. 1053 (1894); Wright & Hester, *supra* note 192, at 377.

194. *See, e.g.*, Kimball Laundry Co. v. United States, 338 U.S. 1 (1949).

195. 16 U.S.C. § 459b-3(a) (2006).

196. Nat'l Park Serv., *Director's Order #25: Land Protection* § 11.3 (2001), *available at* http://www.nps.gov/policy/DOrders/DOrder25.htm.

197. New York employs a similar approach in authorizing acquisition and condemnation of park land pursuant to the Park and Recreation Land Acquisition Bond Acts. New York Parks, Recreation and Historic Preservation

approach, NPS can condemn property but allow the owner to retain possession and use for either up to a 25-year term or a "life estate." These reservations are a "deeded interest," meaning that after conveyance they amount to property rights that may not be abrogated except as provided in the statute. Neither can they be extended. The only substantive difference between such reservations and this Article's proposal for condemning future interests is that under the NPS approach the owner must agree to accept the reservation. Also, in this Article's proposal, the vesting of the government in possession would occur as the seas rise.

Condemnation of future interests in lands identified as having significance for adaptation to sea-level rise will not only give the government full ownership of the land in the future, but it will also enhance regulatory authority immediately. As a future interest holder, government would have the right to bring an action against those currently in possession for "waste," that is, to prevent current changes in use that would cause unreasonable or excessive harm to the reversionary interest.[198] Government rights against waste may permit the government to prohibit some actions that a court might otherwise find to be a taking, such as habitat destruction or construction of a seawall. Such a right would inhere in the title to the property and thus would be included within the exception to the *Lucas* rule.[199]

The question of how much compensation the government would save by condemning only a future interest would depend primarily on how far in the future the government plans to take possession of the property. This depends on the events used to

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Law section 15.11 authorizes the state or municipality in certain circumstances to enter into agreements concerning acquired or taken parkland whereby the owner may continue to occupy and use them for no more than ten years. There is no provision for life estates. N.Y. PARKS REC. & HIST. PRESERV. LAW § 15.11 (Westlaw 2012).

198. On the common law action of the holder of a reversion against waste by the tenant in possession, see JOHN G. SPRANKLING, UNDERSTANDING PROPERTY LAW 126–27 (3d ed. 2012).

199. Peloso & Caldwell, *supra* note 11, at 85. Peloso and Caldwell argue that state governments should be understood, as a matter of law, to have a future interest and also actions for waste against properties on the shore because they will become public trust owners as sea-level rise moves the tideline upland. *Id.* at 83–86. The proposal in this Article concerns lands that will not be inundated in the foreseeable future; it concerns land that the government will decide it needs to fully manage in the future in order to adapt to sea-level rise and other consequences of climate change. It also addresses an explicit acquisition of a future interest rather than arguing that accretion creates a future interest by operation of law.

trigger that right. Generally, *just compensation* means that government must pay fair market value: what a willing buyer would pay a willing seller.[200] Although no case concerning condemnation of a naked future interest could be found, there is established law about how to value a future interest when the government condemns land that already is subject to a future interest; in such a case, compensation must be divided between the present and future interest holders.[201] To determine the value of the government's future interest, one could deduct the value of the present possessory estate from the appraised value of the land. This, of course, requires some estimate of how long the present possessory estate will endure, something analogous to the use of actuarial estimates for the duration of life estates. Alternatively, one could calculate the discounted present value of the right to possess full title to the land at termination of the present possessory estate. This amounts to the current value of full title to the land discounted for the expected time until the seas rise or other conditions are met. This equals the amount of money that, invested now at prevailing interest rates, will equal the dollar value of the fee simple interest in the land at the time the government expects to gain full ownership. The discount rate would be based upon prevailing interest rates because it essentially measures the time value of money. Despite current historically low interest rates, this would save substantial money for events projected into the latter years of this century.

CONCLUSION

Property law sets boundaries between the individual and society. Unprecedented changes in the natural world must change the calculation of what society can require of individual property owners. Sea-level rise changes the extent to which a private owner can develop land at the coast and armor the coastline. Such legal reforms will be made differently in different states and in communities with different property traditions, regulatory structures, and environmental conditions. Constitutional property rights, enforced through the regulatory takings doctrine should be, at most, a loose constraint on how states seek to reform land-use regulation to protect public safety and the environmental services upon which humans collectively rely.

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200. United States v. Miller, 317 U.S. 369, 374 (1943).

201. *See* 4 JULIUS L. SACKMAN & RUSSELL D. VAN BRUNT, NICHOLS ON EMINENT DOMAIN § 12D.03[2]–[3] (3d ed. 2012).